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SYSTEM WISDOM

A Short Guide to Unbreaking the World

Contents

A Note to the Reader

This book is made possible through the influence of works produced by a remarkable array of modern day characters in the sphere of systems, philosophy, wisdom, and life. This list includes the works of thinkers and doers like Nassim Nicholas Taleb, Yaneer Bar-Yam, Joe Norman, Russell Roberts, Rory Sutherland, Peter Thiel, Andrew Gelman, Ole Peters, and Gerd Gigerenzer. These people are wiser and smarter than I. Any errors with regards to concepts from their works are mine. I encourage you to delve deeply into the work they have graciously offered to the world.

1 – Everything is a system.

The entire world is made up of parts that act upon each other. These parts may have clear boundaries, or their boundaries may be fuzzy. Anything that is pieced together with two or more interacting parts is a system. In practice, that means everything is a system because interacting pieces and parts form everything

No matter where you go, you can't escape systems. Every system is part of another system. You are one system. You are also made up of many smaller systems. You have a heart, a brain, many bacterial colonies, which themselves are made up of other systems, and so on.

You are a small part of larger systems which are parts of still more extensive systems. You are part of your family, your community, your town, city, and so on. It's a long chain, and it can get big. You are part of this planet, the galaxy, and this universe, and potentially the multiverse of universes. So is your family, your community, your town, city, and so on. We don't know for sure how far down, up, left, or right this chain goes. One thing is for sure, you are not one separate thing, and we don't operate in a world of single, non-interacting things. Even the furthest thing in this universe from you is interacting with you at this exact moment.

As you go about your day, you may sometimes get the feeling

that a surprising number of systems don't work. You may have noticed that these broken systems tend to be human creations. That feeling is closer to the truth than you might hope. Not every system we've made is broken, but many don't work as we intended.

Your car is a system built to get you to work quickly and efficiently. However, you spend a substantial amount of time in traffic as you inflict expensive damage to the environment. You spend time and money to keep your car clean, maintained, inspected, insured, and fueled up. You dedicate a portion of your earnings to buy and maintain that car. That means you go to your job and do work to afford that car. Because you don't walk to your office or your grocery store, your car also slowly chips away at your health. If you drive long enough, it can eventually land you in an accident that costs you money and your health.

Oh, and you'll need to be focused while you drive, so you shouldn't think too hard or do any other task. Otherwise, your odds of a wreck shoot up. So, you better not day-dream, meditate, or have creative thoughts while you drive. Once you have a car, you need somewhere to store it, so a portion of your house and physical space on the planet needs to be dedicated to your car. You'll need a garage to keep your car, roads to drive on, and a place to park when you get there. These things aren't free in any respect, whether you consider time, money, or resources. When you look at your car like this, it doesn't seem to do its job all that well after all. A car, though, is just one example. Modern life is filled with this sort of thing.

Designers crafted your smartphone to put the power of a supercomputer in your pocket. They want to make you one of the most exceptional humans ever. However, with your smartphone, you waste most of your time distracted by social media notifications. You calculate the correct angle to toss colored lights across the sky in some game designed to empty your pockets 99 cents (plus tax) at a time.

You may notice your ability to converse with real humans decreases as your time with your smartphone increases. Rather than make you feel connected, your phone makes you feel isolated. Your phone, in some respects, makes you less human rather than the best human you could be.

Its powerful tools and apps are supposed to make life easier for you, and yet your stomach drops when you hear the ringtone go off. You lose sleep because of the blue glow from your screen[1]. You dread your phone's alarm in the morning. You feel totally lost and naked if you leave it behind. None of this seems to make for the finest generation of human beings unless your definition of finest is "chronically suffers from neurosis."

Your bank says its job is to keep your money safe. Yet most of the time your money isn't actually there, the bank has used it to make more money off of it. Moreover, every decade or so, your bank manages to lose your and the entire world's collective accounts a ton of money. Then your taxes get used to bail the bank out. Sometimes the banks cause such deep economic problems, that they somehow manage to lose people who don't

[1] https://www.health.harvard.edu/staying-healthy/blue-light-has-a-dark-side

have money in the bank their money too. That's called inflation.

As we look at these examples, we realize that many systems we've built work well at a superficial level, but if you look at them closely, you'll see that they repackage your old problems into new ones.

Not all systems we observe are broken. Evolution, the process by which life on Earth acquires new characteristics, works with natural selection, the mechanism by which useful characteristics survive, to form a reliable system for life on this planet. Life has stuck around here for around 3.5 billion years[2]. Most old natural systems you find today just work. They've survived a really long time. That's why when you look through history, you find so much human admiration for the elegant and yet sophisticated systems you can find in nature. There is delicate harmony and balance to these natural systems that we humans just can't replicate, at least not at any large scale. The fact that these systems have survived for so long is a testament to their ability to not just work, but to adapt to the ringing grooves of change. Despite the chaos humans cause, nature continues to thrive.

The reason nature's systems work so well is the same reason manmade systems don't. You'll find this is especially true of modern manmade systems. Nature started with the most straightforward working system and layered incremental complexity on top over an astronomical time frame. Nature has had a multi-billion year head-start. Even in nature, sometimes things broke. Other times they worked. The stuff that worked

[2] http://exploringorigins.org/timeline.html

stuck around. Eventually, as the system grew in complexity, what stuck around gained a remarkable ability. Once a system is complex it can start to adapt to its environment, so that even when things go wrong, it can find a way forward. In a sense, a complex system has a life of its own. Natural complex systems can re-organize themselves to adapt to a variety of new situations. Nature doesn't usually get stuck in the doldrums, and when it does, it's because it doesn't need to change.

That's nature.

Humans like to do things differently. Unlike nature, which starts things simple and grows complex, humans come in and attempt to design complex systems (or systems that want to be complex) in the blink of an eye. In a few years we want to compete with what nature has tuned for billions of years. We prefer instant gratification. After all, each of us dies within a century or so, and who cares what happens after we're gone. We want things to happen within our lifetimes if not right this second. We pat ourselves on the back for our cleverness, release our creation into the real world, and then watch catastrophe ensue as we decide who and what to blame. Humans design with intent. Nature, as far as we can tell, does not. We intend to create order, but somehow always end up with chaos. Nature intends nothing at all, and somehow has grown the most ordered thing we know: life itself.

This book is about how we can unbreak this world that we've injected with our particular brand of chaos.

But first, let's make sure we speak the same language…

Is it simple, complicated, complex, or just plain nuts?

In everyday language, we don't consider the words "complex" and "complicated" to be different. We say complicated when talking to our friends and complex when we want to sound smart. Or, more often than not, we use them without care about their distinction. However, to be able to talk about systems, we need to treat these two words as separate[3]. In this book, they mean different things to us. While we're at it, we'll go ahead and define "simple" and "chaotic" too.

Something simple doesn't have many parts. Without effort, you can wrap your head around simple things and predict their behavior. A sheet of notebook paper is pretty simple. You can write on it and keep notes. You can draw on it. You can fold it into origami. You can burn it. You can use it to wrap a small box. If you dip it in water, you can predict that you'll ruin it. Simple systems are good places to start because you can see exactly how they work. If they don't work, you can easily reckon what's broken and how to fix it. If your piece of paper has been ripped, you can identify the rip and tape it back together. Now, you may be thinking, "but paper is really not that simple, there are fibers and…" but hold on to that thought for now. We'll come back to it.

A complicated system has many parts. You can't readily wrap your head around it, but if given enough time you can

[3] noop.nl/2008/08/simple-vs-complicated-vs-complex-vs-chaotic.html

eventually figure it all out. You can even break it apart into component systems or pieces to learn how it works. You can still make dependable predictions about the complicated system and the simple individual components that it is made from.

An iPhone is a complicated system. Inside it you'll find a cacophony of parts. It would take you years of study to understand all its parts and how they work together. With enough time, you could do it. Once you did, you could take it all apart and put it back together, or even re-arrange it to make it better for your needs. If you took out one part, say the battery, your phone wouldn't work as well. You can make predictions about how the phone behaves or even how individual pieces of it would behave. For example, you could tell what would happen if I removed the battery from my iPhone. It wouldn't turn on. You can replace the broken battery with one that works and fix the system. Complicated systems are a pain to understand, but once you do, you can control them.

Things that are complex are[4] more bizarre[5]. They rise out of the relationships between the parts of the system. That means *if* you could identify and study at all the individual parts of the system you still wouldn't understand how the system works. Nor could you break the system apart to understand it. Once you break the system, you eliminate the very relationships that made the system…well…the system.

Your immediate family is a complex system. You might have

[4] https://www.mpg.de/36885/cpt08_ComplexSystems-basetext.pdf
[5] http://learningforsustainability.net/post/complicated-complex/

three or five or twelve family members. Or more. Or less. Regardless, a lot is going on in any family. There are components that are invisible but still part of the system. Many of these components, visible and invisible, interact. As they interact, they make your family your family. If you remove a member of your family, then the nature of the family changes. If you introduce a new member to the family you never know what you'll get as a result. It can be arduous to predict what will happen in a family as life happens to it. Things that happen usually don't break the system, but the system may change and adapt to the change in unpredictable ways.

Families are somewhat predictable in general, but very difficult to predict in specifics. You can predict that family members will have similar tastes in food and speak the same language, but you can't predict each person's tastes or the second or third tongues they can speak. As your parents know, and if you are a parent you may know, families are impossible to control. You can guide them in some limited ways, but their complexity puts them beyond any real control. If you've ever needed to arrange your family around a table with assigned seating, you know precisely how intractable complexity can be.

There is something essential to remember when you deal with a complex system. When you poke at a simple or complicated system you can make the system do something you intend. When you poke at a complex system, the complex system may poke back. You'll never know what you'll get until you do it.

Finally, some systems are[6] just plain nuts, or more formally,

[6] https://jech.bmj.com/content/jech/61/11/933.full.pdf

chaotic. Chaotic systems comprise a small number of parts, they may appear simple, but their interactions produce elaborate results. You may be able to understand the underlying parts and superficial relationships, but you won't be able to wrap your head around or predict their results. Chaotic systems aren't necessarily random. Weather is considered a chaotic system. You can predict what tomorrow's temperature will be, but as time goes on, chaotic systems diverge or become more different from themselves. Which means you can't predict what the temperature will be on this day exactly 30 years from now, and especially not on this day exactly 500 years from now, and so on. Finally, as strange as they may be, chaotic systems can be controllable. Interesting as chaotic systems are, we won't delve too much into them in this book as they are more often a mathematical curiosity than systems we want to get working. We don't typically build chaotic systems.

It's about how you look at systems.

Can a system be simple, complicated, complex, and even chaotic all at once? There's no reason it can't be. Take that sheet of paper I told you to hold on to earlier. A sheet of paper is so simple a child can understand it. But what if you look at a sheet of paper at the molecular level? The atomic level? The quantum level? Is it still simple? Maybe. Maybe not. Your zoom level on a system can change whether you see that system as simple, complicated, complex, or even chaotic. The Earth is a complex ecosystem, and on it live a variety of complex systems at all kinds of different scales. Yet, if you're looking at the Earth as a rock that circles the Sun, our planet is a remarkably predictable system. I can't guarantee that it will be there tomorrow, but if it

is, I can tell you with a great deal of confidence exactly where in space it will be, what its tilt is, and so on. Somehow, I still can't predict the next earthquake that will happen on this rock. A system can be simple, complex, complicated, and chaotic at different scales. That means when you want to get a system to work, you need to consider exactly what scale you work in.

Now that you know the different kinds of systems, and critically, the difference between complicated and complex systems, you can approach the broken systems you find in the world with more nuance. Determine if you have to deal with something simple, complicated, complex, or chaotic. Remember, your zoom-level matters.

Not working or not working as intended?

When you see the broken systems around you, you need to ask whether the system doesn't work, or does not work as intended. Humans make systems with intent. Someone wants the system to achieve some result. A bookbinder makes a book to hold the written pages together for you so that you can easily read the book. If the book holds the written pages together and you can easily read the book, the system works as intended.

Systems that come from nature do not have intent. They may sometimes look like they have intent, but they don't. An example of this is DNA, the biological recipe for living organisms on this planet. It may look like DNA has the intent to survive, but DNA is only a recipe. Its survival and its tendency to survive doesn't come from its intentions. Its gravitation towards survival is because some DNA survives and some DNA doesn't. The DNA you see in living organisms has survived, so it looks like it intends to survive. Did all the DNA you don't see intend to die? Probably not. While DNA may have no intentions of its own, intention can emerge from DNA. Life intends to survive.

Human-made systems can fail in two root ways. They might not do anything at all, because they are broken, or they may do something different from what their creator intended. If your lightbulb doesn't light up, then it's not doing anything at all. If your lightbulb lights up but then bursts into flames and sets

your house on fire, then it's not working as intended.

Simple systems, like a sheet of paper, can more easily be made to work, and they're less likely to fail. How often does paper stop being paper? Paper is usually intended to store what you want to draw or write on it. It generally works as intended. Nothing is perfect, not even paper.

Complicated systems demand more effort to get functional, and they are more likely to fail. As fragile as paper is, your sheet of paper is more likely to outlast your car. Your car is intended to get you to work. If it doesn't have gas, or a wheel falls off, it is unlikely to work as intended. Compare that to paper. You can tear a sheet in two and still have two smaller sheets to write on. I have paper in my house that has survived for three centuries. Even the most reliable, well-maintained car today probably won't start three centuries from now, at least not without a Ship of Theseus transformation.

Complex systems behave more oddly. A complex system will always tend to do something, barring some catastrophic failure. Social media platforms are complex systems, at least once you fill them with humans. They generally do *something* unless the whole platform gets shut down, there is a global internet outage, etc. Whether they do what they were intended to do is a different story. If a few people leave a social network, the network still operates, though it may behave, look, and feel different to the people who are left. Complex systems will always do something. The more complex they are, the more difficult, and ultimately impossible it becomes to divine what

they will do.

Part of the reason the systems we create tend to fail or not work as intended is that we prefer to make complicated systems. We make things complicated because we want to be clever, realize our ambitions, or just don't know better, as you'll see later.

The importance of systems.

We live in a world of systems. The whole kit and kaboodle come together in one big, complex system. But, how often do you think about your life, your challenges, and your triumphs in terms of systems? How often do you stop to consider the bigger context?

The answer is not often. Not often was fine a few thousand years ago when your actions didn't have global repercussions. Whether you would plant cabbages or cauliflower in your family's farm wouldn't risk global catastrophe. You would have been too isolated, and the effects of your choices would be slow to spread if at all. With greater interconnectedness and light-speed communication, however, we can do things on a massive scale and at a frightening velocity. Our thinking has to change. To ignore our actions in the context of a vast and fast interconnected system can invite trouble.

Failures to consider our actions in terms of systems may have both helped and hindered our history. Without having to consider our actions and decisions in the context of interacting systems we were able to make rapid strides in many areas. Would we have landed on the moon if we'd considered the systematic effects of leaving debris in orbit around our home planet? Would Einstein have published the $e=mc^2$ equation if he'd known the nuclear arms race it would beget? Sometimes thinking about things in terms of systems can leave you feeling overwhelmed. If nothing else, it will make you feel cautious.

Caution doesn't furnish people with an innovative spirit.

On the other hand, would we want to give up our ambitions in space just because of an orbital garbage problem we can solve? Would we want to forgo and turn in the technological progress of the last century in exchange for more systematic thinking? The answer can go either way, depending on how you think.

Einstein was smart enough to know precisely what $e=mc^2$ would lead to over time. He published his work. Later he encouraged the United States to pursue the atomic bomb lest the Nazis get there first.[7] Einstein published, others might not have. That's a good thing. Diversity of thought is one way complex systems like life make themselves adaptable to random events. There is a push and pull between different ideas that creates something akin to balance.

Eventually, you get to a point where there's no room for debate. Would you give up your ambitions in space if you knew it could, in an ironic twist, doom all life on Earth to extinction? I would. Hopefully, you would too.

Regardless of how you think, you live in a world of systems. To make things happen in this world, to re-organize it into new patterns, you will need to interact with systems, re-organize systems, remove systems, or sometimes invent new systems. You will want those systems to work. Sometimes you may even want systems not to work. This book will teach you just enough

[7] https://news.nationalgeographic.com/2017/06/nuclear-weapons-atom-bomb-einstein-genius-science/

to help you do both.

This book is not intended to make you cower in fear when faced with complex problems. Yes, the world is complex. Yes, complex systems are difficult if not impossible to understand. Yes, complex systems are unpredictable. But, none of those factors precludes you from delving into complex systems, working with them, living in them, or simply enjoying their strangeness. For many thousands of years, humans have done all those things. We have had an unspoken appreciation and humbleness around complexity. That has not meant that we shied away from tough problems. We did, however, approach them with caution. Even when we weren't cautious, we were ultimately kept safe from ourselves by the limited reach of our technology.

Only in recent times have we lost sight of the distinction between simple, complicated, and complex. We've gained just enough knowledge and understanding of the world to make us dangerous to ourselves. We assume everything is simple or complicated. We've forgotten that things can be complex. Our technology amplifies our mistakes. So we treat every problem the same and end up creating things that do us more harm than good in the long run. We have to use different ways to deal with complex systems and problems.