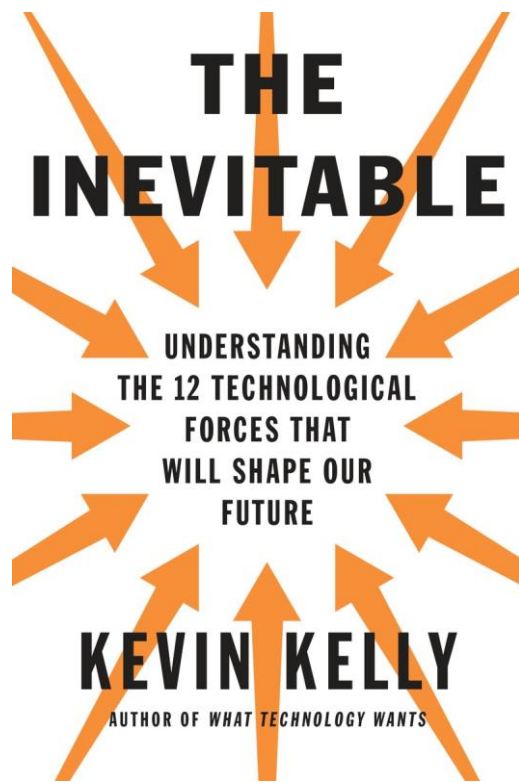


The Inevitable Understanding the 12 Technological Forces That Will Shape Our Future by Kevin Kelly



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1 BECOMING

Technological life in the future will be a series of endless upgrades.

Endless Newbie is the new default for everyone, no matter your age or experience.

2 COGNIFYING

Three recent breakthroughs have unleashed the long-awaited arrival of artificial intelligence:

1. Cheap Parallel Computation
2. Big Data (Every intelligence has to be taught)
3. Better Algorithms

The advent of AI didn't diminish the performance of purely human chess players. Quite the opposite. Cheap, supersmart chess programs inspired more people than ever to play chess, at more tournaments than ever, and the players got better than ever.

There are more than twice as many grand masters now as there were when Deep Blue first beat Kasparov.

If AI can help humans become better chess players, it stands to reason that it can help us become better pilots, better doctors, better judges, better teachers.

Some possible new minds:

1. A mind like a human mind, just faster in answering (the easiest AI mind to imagine).
2. A very slow mind, composed primarily of vast storage and memory.
3. A global supermind composed of millions of individual dumb minds in concert.
4. A hive mind made of many very smart minds, but unaware it/they are a hive.

5. A borg supermind composed of many smart minds that are very aware they form a unity.
6. A mind trained and dedicated to enhancing your personal mind, but useless to anyone else.
7. A mind capable of imagining a greater mind, but incapable of making it.
8. A mind capable of creating a greater mind, but not self-aware enough to imagine it.
9. A mind capable of successfully making a greater mind, once.
10. A mind capable of creating a greater mind that can create a yet greater mind, etc.
11. A mind with operational access to its source code, so it can routinely mess with its own processes.
12. A superlogic mind without emotion.
13. A general problem-solving mind, but without any self-awareness.
14. A self-aware mind, but without general problem solving.
15. A mind that takes a long time to develop and requires a protector mind until it matures.
16. An ultraslow mind spread over large physical distance that appears "invisible" to fast minds.
17. A mind capable of cloning itself exactly many times quickly.
18. A mind capable of cloning itself and remaining in unity with its clones.
19. A mind capable of immortality by migrating from platform to platform.
20. A rapid, dynamic mind capable of changing the process and character of its cognition.
21. A nanomind that is the smallest possible (size and energy profile) self-aware mind.
22. A mind specializing in scenario and prediction making.
23. A mind that never erases or forgets anything, including incorrect or false information.
24. A half-machine, half-animal symbiont mind.
25. A half-machine, half-human cyborg mind. A mind using quantum computing whose logic is not understandable to

To understand how robot replacement will happen, it's useful to break down our relationship with robots into four categories.

1. Jobs Humans Can Do but Robots Can Do Even Better

Humans can weave cotton cloth with great effort, but automated looms make perfect cloth by the mile for a few cents.

A computerized brain known as autopilot can fly a 787 jet unaided for all but seven minutes of a typical flight.

We've accepted utter reliability in robot manufacturing; soon we'll accept the fact that robots can do it better in services and knowledge work too.

2. Jobs Humans Can't Do but Robots Can

Without automation, we could not make a single computer chip—a job that requires degrees of precision, control, and unwavering attention that our animal bodies don't possess. Likewise no human—indeed no group of humans, no matter their education—can quickly search through all the web pages in the world to uncover the one page revealing the price of eggs in Kathmandu yesterday.

We aren't giving "good jobs" to robots. Most of the time we are giving them jobs we could never do. Without them, these jobs would remain undone.

3. Jobs We Didn't Know We Wanted Done

This is the greatest genius of the robot takeover: With the assistance of robots and computerized intelligence, we already can do things we never imagined doing 150 years ago.

It is a safe bet that the highest-earning professions in the year 2050 will depend on automations and machines that have not been invented yet. That is, we can't see these jobs from here, because we can't yet see the machines and technologies that will make them possible. Robots create jobs that we did not even know we wanted done.

4. Jobs Only Humans Can Do—at First

The one thing humans can do that robots can't (at least for a long while) is to decide what it is that humans want to do.

When robots and automation do our most basic work, making it relatively easy for us to be fed, clothed, and sheltered, then we are free to ask, "What are humans for?"

Industrialization did more than just extend the average human lifespan. It led a greater percentage of the population to decide that humans were meant to be ballerinas, full-time musicians, mathematicians, athletes, fashion designers, yoga masters, fan-fiction authors, and folks with one-of-a-kind titles on their business cards. With the help of our machines, we could take up these roles—but, of course, over time the machines will do these as well.

We'll then be empowered to dream up yet more answers to the question "What should we do?" It will be many generations before a robot can answer that.

This postindustrial economy will keep expanding because each person's task (in part) will be to invent new things to do that will later become repetitive jobs for the robots.

In the coming years robot-driven cars and trucks will become ubiquitous; this automation will spawn the new human occupation for former truck drivers of trip optimizer, a person who tweaks the traffic algorithms for optimal energy and time usage.

Routine robosurgery will necessitate the new medical skills of keeping complex machines sterile.

When automatic self-tracking of all your activities becomes the normal thing to do, a new breed of professional analysts will arise to help you make sense of the data. And of course we will need a whole army of robot nannies, dedicated to keeping your personal robots up and running.

Each of these new vocations will in turn be taken over by automation later.

Here are the Seven Stages of Robot Replacement:

1. A robot/computer cannot possibly do the tasks I do.
2. [Later.] OK, it can do a lot of those tasks, but it can't do everything I do.
3. [Later.] OK, it can do everything I do, except it needs me when it breaks down, which is often.
4. [Later.] OK, it operates flawlessly on routine stuff, but I need to train it for new tasks.
5. [Later.] OK, OK, it can have my old boring job, because it's obvious that was not a job that humans were meant to do.
6. [Later.] Wow, now that robots are doing my old job, my new job is much more interesting and pays more!
7. [Later.] I am so glad a robot/computer cannot possibly do what I do now.
[Repeat.]

This is not a race against the machines. If we race against them, we lose. This is a race with the machines. You'll be paid in the future based on how well you work with robots.

We need to let robots take over.

Many of the jobs that politicians are fighting to keep away from robots are jobs that no one wakes up in the morning really wanting to do.

Robots will do jobs we have been doing, and do them much better than we can.

They will do jobs we can't do at all. They will do jobs we never imagined even needed to be done. And they will help us discover new jobs for ourselves, new tasks that expand who we are.

They will let us focus on becoming more human than we were. It is inevitable.

Let the robots take our jobs, and let them help us dream up new work that matters.

3 FLOWING

Here are eight generatives that are “better than free.”

1. IMMEDIACY

- Sooner or later you can find a free copy of whatever you want, but getting a copy delivered to your inbox the moment it is released—or even better, produced—by its creators is a generative asset.

2. PERSONALIZATION

- A generic version of a concert recording may be free, but if you want a copy that has been tweaked to sound acoustically perfect in your particular living room—as if it were being performed in your room—you may be willing to pay a lot.

3. INTERPRETATION

- As the old joke goes: “Software, free. User manual, \$10,000.” But it’s no joke. A couple of high-profile companies, like Red Hat, Apache, and others make their living selling instruction and paid support for free software. The copy of code, being mere bits, is free. The lines of free code become valuable to you only through support and guidance.

4. AUTHENTICITY

- You might be able to grab a popular software application for free on the dark net, but even if you don’t need a manual, you might want to be sure it comes without bugs, malware, or spam. In that case you’ll be happy to pay for an authentic copy.

5. ACCESSIBILITY

- Ownership often sucks. You have to keep your things tidy, up-to-date, and, in the case of digital material, backed up. And in this mobile world, you have to carry it along with you. Many people, myself included, will be happy to have others tend our “possessions” while we lazily subscribe to them on the cloud.

6. EMBODIMENT

- At its core the digital copy is without a body. I am happy to read a digital PDF of a book, but sometimes it is luxurious to have the

same words printed on bright white cottony paper bound in leather.
Feels so good.

7. PATRONAGE

- Deep down, avid audiences and fans want to pay creators. Fans love to reward artists, musicians, authors, actors, and other creators with the tokens of their appreciation, because it allows them to connect with people they admire. But they will pay only under four conditions that are not often met:
 - It must be extremely easy to do;
 - The amount must be reasonable;
 - There's clear benefit to them for paying; and
 - It's clear the money will directly benefit the creators.

8. DISCOVERABILITY

- No matter what its price, a work has no value unless it is seen.
- When there are millions of books, millions of songs, millions of films, millions of applications, millions of everything requesting our attention—and most of it free—being found is valuable.

These eight qualities require a new skill set for creators. Success no longer derives from mastering distribution. Distribution is nearly automatic; it's all streams.

The Great Copy Machine in the Sky takes care of that. The technical skills of copy protection are no longer useful because you can't stop copying.

These are the Four Stages of Flowing:

1. Fixed. Rare.

- The starting norm is precious products that take much expertise to create. Each is an artisan work, complete and able to stand alone, sold in high-quality reproductions to compensate the creators.

2. Free. Ubiquitous.

- The first disruption is promiscuous copying of the product, duplicated so relentlessly that it becomes a commodity. Cheap, perfect copies are spent freely, dispersed anywhere there is demand. This extravagant dissemination of copies shatters the established economics.

3. Flowing. Sharing.

- The second disruption is an unbundling of the product into parts, each element flowing to find its own new uses and to be remixed into new bundles. The product is now a stream of services issuing from the shared cloud. It becomes a platform for wealth and innovation.

4. Opening. Becoming.

- The third disruption is enabled by the previous two. Streams of powerful services and ready pieces, conveniently grabbed at little cost, enable amateurs with little expertise to create new products and brand-new categories of products. The status of creation is inverted, so that the audience is now the artist. Output, selection, and quality skyrocket.

4 SCREENING

Today more than 5 billion digital screens illuminate our lives.

Digital display manufacturers will crank out 3.8 billion new additional screens per year.

That's nearly one new screen each year for every human on earth.

We will start putting watchable screens on any flat surface.

Humans have "published":

- at least 310 million books
- 1.4 billion articles and essays
- 180 million songs
- 3.5 trillion images
- 330,000 movies
- 1 billion hours of videos, TV shows, and short films,
- and 60 trillion public web pages

All this material is currently contained in all the libraries and archives of the world.

When fully digitized, the whole lot could be compressed (at current technological rates) onto 50-petabyte hard disks.

Ten years ago you needed a building about the size of a small-town library to house 50 petabytes.

Today the universal library would fill your bedroom. With tomorrow's technology, it will all fit onto your phone.

When that happens, the library of all libraries will ride in your purse or wallet—if it doesn't plug directly into your brain with thin white cords.

Some people alive today are surely hoping that they die before such things happen, and others, mostly the young, want to know what's taking so long.

What happens when all the books in the world become a single liquid fabric of interconnected words and ideas? Four things:

1. First, works on the margins of popularity will find a small audience larger than the near zero audience they usually have now.
2. Second, the universal library will deepen our grasp of history, as every original document in the course of civilization is scanned and cross-linked.
3. Third, the universal networked library of all books will cultivate a new sense of authority. If you can truly incorporate all texts—past and present in all languages—on a particular subject, then you can have a clearer sense of what we as a civilization, a species, do and don't know.
4. Fourth and finally, the full, complete universal library of all works becomes more than just a better searchable library.

5 ACCESSING

Possession is not as important as it once was. Accessing is more important than ever.

Five deep technological trends accelerate this long-term move toward accessing and away from ownership.

1. Dematerialization

The trend in the past 30 years has been to make better stuff using fewer materials.

A classic example is the beer can, whose basic shape, size, and function have been unchanged for 80 years.

- In 1950 a beer can was made of tin-coated steel and it weighed 73 grams.
- In 1972 lighter, thinner, cleverly shaped aluminum reduced the weight to 21 grams.
- Further ingenious folds and curves introduced yet more reductions in the raw materials such that today the can weighs only 13 grams, or one fifth of its original weight.

The weight of the average automobile has fallen by 25 percent.

However, the total amount of material we use per GDP dollar is going down, which means we use less material for greater value.

As cars become more digital, they will tend to be swapped and shared and used in the same social way we swap digital media.

The switch from “ownership that you purchase” to “access that you subscribe to” overturns many conventions.

2. Real-Time On Demand

Uber, the on-demand taxi service, has disrupted the transportation business because it shifts the time equation.

When you order a ride, you don't need to tell Uber where you are; your phone does that.

You don't have to settle payment at the end; your phone does that.

Uber uses the phones of the drivers to locate precisely where they are within inches, so Uber can match a driver closest to you.

3. Decentralization

The glue that holds together institutions and processes as they undergo massive decentering is cheap, ubiquitous communication.

Nearly every aspect of modern civilization has been flattening down except one: money.

But what if you could decentralize money as well?

What if you created a distributed currency that was secure, accurate, and trustworthy without centralization? Because if money could be decentralized, then anything can be decentralized.

But even if you could, why would you?

Bitcoin.

4. Platform Synergy

A platform is a foundation created by a firm that lets other firms build products and services upon it.

5. Clouds

A cloud is a colony of millions of computers that are braided together seamlessly to act as a single large computer.

6 SHARING

1. Sharing

- The online public has an incredible willingness to share.

2. Cooperation

- When individuals work together toward a large-scale goal, it produces results that emerge at the group level.

3. Collaboration

- Organized collaboration can produce results beyond the achievements of ad hoc cooperation. Just look at any of hundreds of open source software projects, such as the Linux operating system, which underpins most web servers and most smartphones. In these endeavors, finely tuned communal tools generate high-quality products from the coordinated work of thousands or tens of thousands of members.

4. Collectivism

7 FILTERING

There has never been a better time to be a reader, a watcher, a listener, or a participant in human expression. An exhilarating avalanche of new stuff is created every year.

We employ all manner of filtering to winnow the bewildering spread of options. Many of these filters are traditional and still serve well:

- We filter by gatekeepers:
 - Authorities, parents, priests, and teachers shield the bad and selectively pass on “the good stuff.”
- We filter by intermediates:
 - Sky high is the reject pile in the offices of book publishers, music labels, and movie studios. They say no much more often than yes, performing a filtering function for what gets wide distribution. Every headline in a newspaper is a filter that says yes to this information and ignores the rest.
- We filter by curators:
 - Retail stores don’t carry everything, museums don’t show everything, public libraries don’t buy every book. All these curators select their wares and act as filters.
- We filter by brands:
 - Faced with a shelf of similar goods, the first-time buyer retreats to a familiar brand because it is a low-effort way to reduce the risk of the purchase. Brands filter through the clutter.
- We filter by government:

- Taboos are prohibited. Hate speech or criticism of leaders or of religion is removed. Nationalistic matters are promoted.
- We filter by our cultural environment:
 - Children are fed different messages, different content, different choices depending on the expectations of the schools, family, and society around them.
- We filter by our friends:
 - Peers have great sway over our choices. We are very likely to choose what our friends choose.
- We filter by ourselves:
 - We make choices based on our own preferences, by our own judgment. Traditionally this is the rarest filter.

The danger of being rewarded with only what you already like, however, is that you can spin into an egotistical spiral, becoming blind to anything slightly different, even if you'd love it. This is called a filter bubble. The technical term is "overfitting."

Here is a picture of where this force is taking us. My day in the near future will entail routines like this:

I have a pill-making machine in my kitchen, a bit smaller than a toaster. It stores dozens of tiny bottles inside, each containing a prescribed medicine or supplement in powdered form. Every day the machine mixes the right doses of all the powders and stuffs them all into a single personalized pill (or two), which I take. During the day my biological vitals are tracked with wearable sensors so that the effect of the medicine is measured hourly and then sent to the cloud for analysis. The next day the dosage of the medicines is adjusted based on the past 24-hour results and a new personalized pill produced. Repeat every day thereafter. This appliance, manufactured in the millions, produces mass personalized medicine.

In the United States, TV still captures most of our attention, followed by radio, and then the internet. These three take the majority of our attention, while the others—books, newspapers, magazines, music, home video, games—consume only slivers of the total pie. But not all attention is equal. In the advertising business, quantity of attention is often

reflected in a metric called CPM, or cost per thousand (M is Latin for “thousand”). That’s a thousand views, or a thousand readers or listeners. The estimated average CPM of various media platforms ranges widely. Cheap outdoor billboards average \$3.50, TV is \$7, magazines earn \$14, and newspapers \$32.50.

8 REMIXING

Since one can combine hundreds of simpler technologies with hundreds of thousands of more complex technologies, there is an unlimited number of possible new technologies—but they are all remixes.

9 INTERACTING

Virtual reality (VR) is a fake world that feels absolutely authentic.

In the coming decades we’ll keep expanding what we interact with. The expansion follows three thrusts.

1. More senses

- We will keep adding new sensors and senses to the things we make. Of course, everything will get eyes (vision is almost free), and hearing, but one by one we can add superhuman senses such as GPS location sensing, heat detection, X-ray vision, diverse molecule sensitivity, or smell. These permit our creations to respond to us, to interact with us, and to adapt themselves to our uses. Interactivity, by definition, is two way, so this sensing elevates our interactions with technology.

2. More intimacy

The zone of interaction will continue to march closer to us. Technology will get closer to us than a watch and pocket phone. Interacting will be more intimate. It will always be on, everywhere. Intimate technology is a wide-open frontier. We think technology has saturated our private space, but we will look back in 20 years and realize it was still far away in 2016.

3. More immersion

- Maximum interaction demands that we leap into the technology itself. That’s what VR allows us to do. Computation so close that we

are inside it. From within a technologically created world, we interact with each other in new ways (virtual reality) or interact with the physical world in a new way (augmented reality). Technology becomes a second skin.

10 TRACKING

Digital magic has shrunk devices such as thermometers, heart rate monitors, motion trackers, brain wave detectors, and hundreds of other complex medical appliances to the size of words

Computer scientist Larry Smarr tracks about a hundred health parameters on a daily basis,

Self-tracking is much broader than health. It is as big as our life itself. Tiny wearable digital eyes and ears can record every second of our entire day—who we saw and what we said—to aid our memories.

An embrace of an expanded version of lifelogging would offer these four categories of benefits:

A constant 24/7/365 monitoring of vital body measurements.

Imagine how public health would change if we continuously monitored blood glucose in real time.

Imagine how your behavior would change if you could, in near real time, detect the presence or absence of biochemicals or toxins in your blood picked up from your environment. (You might conclude: "I'm not going back there!")

This data could serve both as a warning system and also as a personal base upon which to diagnose illness and prescribe medicines.

An interactive, extended memory of people you met, conversations you had, places you visited, and events you participated in.

This memory would be searchable, retrievable, and shareable.

A complete passive archive of everything that you have ever produced, wrote, or said.

Deep comparative analysis of your activities could assist your productivity and creativity.

A way of organizing, shaping, and "reading" your own life.

To the degree this lifelog is shared, this archive of information could be leveraged to help others work and to amplify social interactions.

In the health realm, shared medical logs could rapidly advance medical discoveries.

I rounded up all the devices and systems in the U.S. that routinely track us.

- Car movements
 - Every car since 2006 contains a chip that records your speed, braking, turns, mileage, accidents whenever you start your car.
- Highway traffic
 - Cameras on poles and sensors buried in highways record the location of cars by license plates and fast-track badges. Seventy million plates are recorded each month.
- Ride-share taxis
 - Uber, Lyft, and other decentralized rides record your trips.
- Long-distance travel
 - Your travel itinerary for air flights and trains is recorded.
- Drone surveillance
 - Along U.S. borders, Predator drones monitor and record outdoor activities.
- Postal mail
 - The exterior of every piece of paper mail you send or receive is scanned and digitized.
- Utilities

- Your power and water usage patterns are kept by utilities. (Garbage is not cataloged, yet.)
- Cell phone location and call logs
 - Where, when, and who you call (metadata) is stored for months. Some phone carriers routinely store the contents of calls and messages for days to years.
- Civic cameras
 - Cameras record your activities 24/7 in most city downtowns in the U.S. Commercial and private spaces—Today 68 percent of public employers, 59 percent of private employers, 98 percent of banks, 64 percent of public schools, and 16 percent of homeowners live or work under cameras.
- Smart home
 - Smart thermostats (like Nest) detect your presence and behavior patterns and transmit these to the cloud. Smart electrical outlets (like Belkin) monitor power consumption and usage times shared to the cloud.
- Home surveillance
 - Installed video cameras document your activity inside and outside the home, stored on cloud servers.
- Interactive devices
 - Your voice commands and messages from phones (Siri, Now, Cortana), consoles (Kinect), smart TVs, and ambient microphones (Amazon Echo) are recorded and processed on the cloud.
- Grocery loyalty cards
 - Supermarkets track which items you purchase and when.
- E-retailers
 - Retailers like Amazon track not only what you purchase, but what you look at and even think about buying.
- IRS
 - Tracks your financial situation all your life.
- Credit cards
 - Of course, every purchase is tracked. Also mined deeply with sophisticated AI for patterns that reveal your personality, ethnicity, idiosyncrasies, politics, and preferences.
- E-wallets and e-banks

- Aggregators like Mint track your entire financial situation from loans, mortgages, and investments. Wallets like Square and PayPal track all purchases.
- Photo face recognition
 - Facebook and Google can identify (tag) you in pictures taken by others posted on the web. The location of pictures can identify your location history.
- Web activities
 - Web advertising cookies track your movements across the web. More than 80 percent of the top thousand sites employ web cookies that follow you wherever you go on the web. Through agreements with ad networks, even sites you did not visit can get information about your viewing history.
- Social media
 - Can identify family members, friends, and friends of friends. Can identify and track your former employers and your current work mates. And how you spend your free time.
- Search browsers
 - By default Google saves every question you've ever asked forever.
- Streaming services
 - What movies (Netflix), music (Spotify), video (YouTube) you consume and when, and what you rate them. This includes cable companies; your watching history is recorded.
- Book reading
 - Public libraries record your borrowings for about a month. Amazon records book purchases forever. Kindle monitors your reading patterns on ebooks—where you are in the book, how long you take to read each page, where you stop.
- Fitness trackers
 - Your physical activity, time of day, sometimes location, often tracked all 24 hours, including when you sleep and when you are awake each day.

11 QUESTIONING

Every minute a new impossible thing is uploaded to the internet and that improbable event becomes just one of hundreds of extraordinary events

that we'll see or hear about today. The internet is like a lens that focuses the extraordinary into a beam, and that beam has become our illumination. It compresses the unlikely into a small viewable band of everydayness.

Every year humans ask the internet 2 trillion questions, and every year the search engines give back 2 trillion answers. Most of those answers are pretty good. Many times the answers are amazing. And they are free!

In 2007, I calculated the cost to Google to answer one query to be approximately 0.3 cents, which has probably decreased a bit since then. By my calculations Google earns about 27 cents per search/answer from the ads placed around its answers, so it can easily afford to give its answers away for free.

Very soon now we'll live in a world where we can ask the cloud, in conversational tones, any question at all.

Abundant answers simply generate more questions!

- A good question is not concerned with a correct answer.
- A good question cannot be answered immediately.
- A good question challenges existing answers.
- A good question is one you badly want answered once you hear it, but had no inkling you cared before it was asked.
- A good question creates new territory of thinking.
- A good question reframes its own answers.
- A good question is the seed of innovation in science, technology, art, politics, and business.
- A good question is a probe, a what-if scenario.
- A good question skirts on the edge of what is known and not known, neither silly nor obvious.
- A good question cannot be predicted.
- A good question will be the sign of an educated mind.
- A good question is one that generates many other good questions.
- A good question may be the last job a machine will learn to do.
- A good question is what humans are for.

12 BEGINNING

At its core 7 billion humans, soon to be 9 billion, are quickly cloaking themselves with an always-on layer of connectivity that comes close to directly linking their brains to each other.

I'm calling this planetary layer the holos. By holos I include the collective intelligence of all humans combined with the collective behavior of all machines, plus the intelligence of nature, plus whatever behavior emerges from this whole. This whole equals holos.

The scale of what we are becoming is simply hard to absorb. It is the largest thing we have made. Let's take just the hardware, for example.

- Today there are 4 billion mobile phones and 2 billion computers linked together into a seamless cortex around the globe.
- Add to them all the billions of peripheral chips and affiliated devices from cameras to cars to satellites.
- Already in 2015 a grand total of 15 billion devices have been wired up into one large circuit.
- Each of these devices contains 1 billion to 4 billion transistors themselves, so in total the holos operates with a sextillion transistors (10 with 21 zeros).
- These transistors can be thought of as the neurons in a vast brain.
- The human brain has roughly 86 billion neurons, or a trillion times fewer than the holos.
- In terms of magnitude, the holos already significantly exceeds our brains in complexity.
- And our brains are not doubling in size every few years.
- The holos mind is.

It processes 1 million emails each second, and 1 million messages per second.

And who will write the code that makes this global system useful and productive?

We will.

We think we are merely wasting time when we surf mindlessly or post an item for our friends, but each time we click a link we strengthen a node somewhere in the holos mind, thereby programming it by using it.

Think of the 100 billion times per day humans click on a web page as a way of teaching the holos what we think is important.

Each time we forge a link between words, we teach this contraption an idea.

Right now, in this Beginning, this imperfect mesh spans 51 billion hectares, touches 15 billion machines, engages 4 billion human minds in real time, consumes 5 percent of the planet's electricity, runs at inhuman speeds, tracks half our daytime hours, and is the conduit for the majority flow of our money.

I describe in this book—sharing, accessing, tracking—come to dominate our institutions and personal lives.

As the new phase congeals, these forces will continue to intensify.

Sharing, though excessive to some now, is just beginning.

The switch from ownership to access has barely begun.

Flows and streams are still trickles.

While it seems as if we are tracked too much already, we'll be tracking a thousand times as much in the coming decades.

Each one of these functions will be accelerated by high-quality cognification, just now being born, making the smartest things we do today seem very dumb.

None of this is final.

These transitions are but the first step in a process, a process of becoming.

It is a Beginning.