

The 20th century saw a global infant mortality decrease of 90%, a maternal mortality decrease of 99%, and human lifespan increase of more than 100%. Today even the poorest Americans have access to a telephone, television, and a flush toilet—3 luxuries that even the wealthiest couldn't imagine at the turn of the last century.

Pandemics do not respect borders, terrorist organizations operate on a global scale, and overpopulation is everybody's problem. The best way to solve these issues is to raise global standards of living. There is an inverse relation between quality of life and population growth rates--as quality increases, birth rates decrease. In today's hyperlinked world, solving problems anywhere, solves problems everywhere. The advancement of new, transformational technologies—computational systems, networks, and sensors, artificial intelligence (AI), robotics, biotechnology, bioinformatics, 3-D printing, nanotechnology, human-matching interfaces, and biomedical engineering—will soon enable the vast majority of humanity to experience what only the affluent have access to today.

There are 3 forces at work, each augmented by the power of exponentially growing technologies and each with significant, abundance-producing potential. The first is a **Do-It-Yourself (DIY) revolution**. It has been growing for the past 50 years, but lately it's begun to bubble over. These days, small groups of motivated DIY-ers can accomplish what was once the sole province of large corporations and governments. Burt Rutan flew into space and Craig Venter tied the mighty US government in the race to sequence the human genome. The 2<sup>nd</sup> force is money—a lot of money—being spent in a **very particular way**. The high-tech revolution created an entirely new breed of wealthy technophilanthropists who are using their fortunes to solve global, abundance-related challenges. Bill Gates is crusading against malaria; Mark Zuckerberg is working to reinvent education; while Pierre and Pam Omidyar are focused on bringing electricity to the developing world. The 3<sup>rd</sup> force is the **combination of the internet, micro-finance, and wireless communication technology in transforming the poorest of the poor into an emerging market force**. Imagine a world of 9B people with clean water, nutritious food, affordable housing, personalized education, top-tier medical care, and nonpolluting, ubiquitous energy. Abundance is about creating a world of possibility: a world where everyone's days are spent dreaming and doing, not scrapping and scraping. More folks have access to a cell phone than a toilet.

**The key to population growth is to improve health. There is a strong correlation, as you improve health, within half a generation, the population growth rate goes down.** Once our basic survival needs are fulfilled, the next level up the

abundance pyramid is energy, education, and information/communication. Energy provides the means to do work; education allows workers to specialize; information/communication abundance not only furthers specialization (through expanding educational opportunities), it allows specialists to exchange specialties, thus creating what economist Friedrich Hayek called catallaxy: the ever-expanding possibility generated by the division of labor. Trade is often unequal but it still benefits both sides.

A 2007 UN report found that 90% of all wood removals in Africa are used for energy. Thus providing the power to run a cookstove will also help preserve endangered forests and the entire litany of ecosystem services those forests provide. Ecosystem services are things like crop pollination, carbon sequestration, climate regulation, water purification, air purification, nutrient dispersal, nutrient recycling, waste processing, flood control, pest control, disease control, and so forth that the environment provides for us free of charge. This is a big deal because the value of the ecosystems services our environment now provides (for free) has been calculated at \$36T a year. None of these are services we can yet provide for ourselves at any price.

A profound change would be education, specifically teaching every child on the planet the basics of literacy, mathematics, life skills, and critical thinking. Our current system is built around fact-based learning, but the Internet makes almost every fact instantly available. This means we're training our children in skills they rarely need, while ignoring those they absolutely do. Teaching kids how to nourish their creativity and curiosity, while providing a sound foundation in critical thinking, literacy and math, is the best way to prepare them for a future of increasingly rapid technological change. Epistemologists agree that you learn through doing. This suggests that if you want more learning, you want more doing. The OLPC (One Laptop Per Child) puts an emphasis on software tools for exploring and expressing, rather than instruction.

**The impact of the mobile phone in Africa has had about the same effect as a democratic change of leadership.** Abundance culminates with improvements in health and freedom, a pair of concepts that strengthen each individual's ability to matter. A certain level of freedom also emerges organically in response to certain new technologies—especially those of the communication and information variety. Empowering people with tools for open expression puts increasing pressure on undemocratic leaders while concurrently expanding the rights of the public.

**Heuristics are cognitive shortcuts:** time-saving energy-saving rules of thumb that allow us to simplify the decision-making process. When **visibility** is poor and the contours

of objects are blurry, we tend to overestimate distance. The inverse is also true. When visibility is good and objects are crisp, we err in the opposite direction. Thus the reliance on clarity as an indication of distance leads to a common bias.

**Confirmation bias** is a tendency to search for or interpret information in a way that confirm one's preconceptions—but it can often limit our ability to take in new data and change old opinions. **Negativity bias**—the tendency to give more weight to negative information and experiences than positive ones—sure aren't helping matters. Age-adjusted cancer rates are falling, not rising. Then there's **anchoring**: the predilection for relying too heavily on one piece of information when making decisions. When people believe the world's falling apart, it's often an anchoring problem. **Bandwagon effect**—the tendency to do or believe things because others do—so even if you suspect there is real cause for optimism, these two biases will team up and make you doubt your own opinion.

There are also larger patterns in our biases. If you believe your own life is hopeless, then what's the point of pushing on? To guard against this, we've developed a psychological immune system: a set of biases that keep us ridiculously cocksure. In hundreds of studies, researchers have consistently found that we **overestimate** our own attractiveness, intelligence, work ethic, chances for success (winning the lottery), chances of avoiding a negative outcome (bankruptcy, getting cancer), impact on external events, impact on other people, and even the superiority of our own peer group (the Lake Wobegon effect). Human beings are designed to be **local optimists and global pessimists** and this is an even bigger problem for abundance. Anchoring shows there is a direct link between imagination and perception. We're also control fiends and are significantly more optimistic about things we believe we can control.

The first filter of incoming information encounters the amygdala part of our brain. Once stimulated, the amygdala becomes hyper vigilant. Bad news sells because the amygdala is always looking for something to fear. Attention is a seriously limited resource, and once we're focused on one thing, we often don't notice the next. Of course any fear response only amplifies the effect. What this means is that **once the amygdala begins hunting bad news, it's mostly going to find bad news. It's hard to be optimistic, because the brain's filtering architecture is pessimistic by design.** Good news is also drowned out because it's in the media's best interest to over-emphasize. Prosocial behaviors are hardwired into the brain, but they are wired into the slower-moving prefrontal cortex. A week's worth of the New York Times contains more information than the average 17<sup>th</sup> century citizen encountered in a lifetime. And the volume is growing exponentially, with technologies doubling in power and halving in price every 18

months. **These combine to leave a blind spot for the technological possibilities underlying our vision of abundance.**

People tend to self-organize in groups of 150—now known as Dunbar's number. This is the upper limit to how many interpersonal relationships our brains can process. Because of amygdala function and media competition, our airwaves are full of prophets of doom. Because of the negativity bias and the **authority bias**—our tendency to trust authority figures—we're inclined to believe them. Our **in-group bias** (a tendency to give preferential treatment to those people we believe in our own group) makes us trust them even more. Whatever information the amygdala doesn't catch, our confirmation bias certainly does. **Loss aversion** (a tendency for people to regret a loss more than a similar gain) may be the bias with the most impact on abundance, keeping people stuck in a rut.

The best definition of prosperity is simply "saved time." The true measure of something's worth is the hours it takes to acquire it. **Poverty was reduced more in the past 50 years than in the previous 500.** Forces which at first make inequality self-accentuating later tend to diminish it. This is exactly what's happening in Africa today: the lower classes are gathering speed and gaining independence. For example, the spread of the cell phone is enabling microfinance, and microfinance is enabling the spread of the cell phone, and both are creating greater intra-class opportunity (meaning fewer jobs that directly depend on the rich) and greater prosperity for everyone involved.

Beyond economic measures, both political liberty and civil rights have also improved substantially these past few centuries. Slavery, for example, has gone from a common global practice to one outlawed everywhere.

Specialization encourages innovation, because it encourages the investment of time in a tool-making tool. **Time saved is proportional to the division of labor.** Culture is the ability to store, exchange, and improve ideas. A large proportion of our high standard of living today derives not just from our ability to more cheaply manufacture the commodities of 1800, but from our ability to manufacture whole new types of commodities, some of which do a better job of meeting needs than we had back in 1800, and some of which meet needs unimagined back in 1800. In a world of material goods and exchange, trade is a zero-sum game. But if you have an idea and I have an idea, and we exchange them, then we both have 2 ideas. It's nonzero.

A team of researchers (described in [The Singularity is Near](#), Kurzweil) spent almost a decade plotting the exponential future of dozens of technologies, while trying to understand the ramifications this much progress had for the human race. The results are staggering and controversial. Using current technologies and projecting forward using Moore's law,

the average laptop should be computing at the rate of the human brain in less than 15 years. The planet itself—natural systems, human systems, physical objects—has always generated an enormous amount of data, but we weren't able to hear it, to see it, to capture it. But now we can because all of this stuff is now instrumented. And it's all interconnected, so now we can actually have access to it. So, in effect, the planet has grown a central nervous system.

3-D printing drops manufacturing costs precipitously. Computing is virtually free. Scalability is now accessible through the cloud. Lab-on-a-Chip technologies will provide accurate, low-cost, easy-to-use, point-of-care diagnostics designed for the 60% of the developing world that lives beyond the reach of urban hospitals and medical infrastructures. Nanotechnology (the manipulation of matter at the atomic scale), biotechnology, AI and robotics have the potential to enhance human performance, to bring sustainable development for materials, water, energy, and food, to protect against unknown bacteria and viruses, and even to diminish the reasons for breaking the peace (by creating universal abundance).

Graduate students are now challenged to develop a company, product, or organization that will positively affect the lives of a billion people within 10 years. New technology creates greater opportunities for specialization, which increases cooperation, which leads to more capability, which generates new technology and starts the whole process over again. It's a self-amplifying mechanism. In the same way that Moore's law is the result of faster computers being used to design the next generation of faster computers, the tools of cooperation always beget the next generation of tools of cooperation.

Better rainfall makes conflict less likely. 200 rivers and 300 lakes share international boundaries, and not all of these neighbors are friendly. With 3.5M people dying annually from water-related illnesses, nothing is clearer than the direct ties between health and hydration. Humans annually consume almost 50B liters of bottled water. Most of this water is what's known as "fossil water," meaning that it took tens of thousands of years to accumulate in aquifers and is not easily replenished. Of the 1.1B people in the world without access to safe water 85% of them live in the countryside. Major aquifers in both China and India are almost gone, resulting in dust bowls far worse than the American Midwest suffered in the 1930s.

Farming is just a 12,000-yr-old way of optimizing lunch. Almost by definition, all crop plants are "genetically modified." The 1.7 M hectares of biotech crops in the world in 1996 had jumped to 148M in 2010. Genetically Engineered (GE) crops are a move from evolution by natural selection to evolution by intelligent direction. Hydroponics, the growing of food in a nutrient-rich solution, is a modern development and

70% more water efficient than traditional agriculture. Aeroponics (the process of growing plants in an air or mist environment without the use of soil or an aggregate medium) is 70% more efficient than hydroponics. Thus, if we used aeroponics for agriculture, we could drop agricultural water use by over 90%.

It takes 10 calories of oil to produce 1 calorie of plant food, and 54 calories for 1 of beef. Livestock production accounts for 70% of all agricultural lands and covers 30% of all land surface on the planet. And as people rise out of poverty their taste for meat rises too. Between 1990 and 2002, China's level of meat consumption doubled. But something is changing. From 1950 to 2007 global aquaculture (the farming of aquatic organisms such as fish, crustaceans, mollusks and aquatic plants) yields increased from 2M metric tons to 50M metric tons. Aquaculture is now the fastest growing animal food production system, supplying nearly 30% of our seafood. Large-scale cultured meat production in bioreactors is a new alternative. While aquaculture is here today, the GE industry is dominated by 3 seeds (cotton, corn, soybeans) and has yet to penetrate deeply into the food crop market.

Because the quality of our tools has finally caught up to the scope of their vision, **small groups of dedicated DIY innovators can now tackle problems that were once solely the purview of big governments and large corporations.** Space flight, unmanned air vehicles, bio-engineering, and social entrepreneurship via nonprofits (micro-finance) are areas where this is happening. What seems to unify them is a high level of optimism, a magnanimous sphere of caring, and a hearty appetite for the big and bold. In 1892, 31% of all American millionaires lived in New York City. There is scarcely a museum, art gallery, concert hall, orchestra, theater, university, seminary, charity, or social or educational institution in New York that does not owe its beginnings and support to these men. While the industrial revolution focused philanthropy locally, the high-tech revolution inverted the equation. There's a different mentality now because the world is much more globally connected. Problems and solutions are interrelated as well.

One concept lately gaining momentum is "impact investing" or "triple-bottom-line investing," whereby investors back businesses that generate financial returns and meet measurable social or environmental goals. Another secret is a hands-on approach. Today's technophilanthropists have the energy and confidence that come from building global businesses at a young age. They want to tackle audacious goals and think they can really make a difference in their lifetimes. All of these have compounded, turning the technophilanthropists into **hyperagents, who have the capacity to do some essential things far better than anyone else.** They do not face elections every few years, like politicians, or suffer the tyranny of shareholder demands for ever-increasing profits, like

CEOs of most public companies. Ratan Tata's efforts at the Nano (the tiny car with the even tinier price tag) jump-started an innovation trend. A dozen plus companies, including Ford, Honda, GM, Renault, and BMW, are now developing cars for emerging markets. Choice was the missing ingredient for 4B people who now have a way and a reason to participate in the global conversation. This new generation growing up with freedom of communication are plugged into an information and entertainment world that didn't exist before.

Poverty traps include being a landlocked nation without access to shipping or being stuck in a cycle of civil war. Another is a resource curse (like oil), which drives up the currency and has the downstream effect of making other exportable commodities uncompetitive. There is no easy way to break the resource curse, but two of the more effective measures are the development of diversified markets and the emergence of a free press (and the transparency it brings). The free flow of information enabled by cell phones replaces the need for a free press and can have serious impacts on the spread of democracy. Both are now a part of the wireless landscape. Micro-credit gives people outside the natural resource game access to money, thus encouraging the creation of small businesses not linked to the boom-and-bust cycle. The average smart phone is as powerful as a high-end PC of less than a decade ago. With over 5B individuals currently armed with mobile phones, they have unprecedented levels of access and insight into the psyches of over 2/3 of the world's population.

New studies show the impact of coffee houses on the Enlightenment culture of the 18<sup>th</sup> century. **The coffee house was a hub for information sharing. 2/3 of all growth takes place in cities because our urban spaces are perfect innovation labs.** And the more complicated, multilingual, multicultural, wildly diverse the city, the greater its output of new ideas. What drives a city's innovation engine is its multitude of differences. When a city's population doubles, there is a 15% increase in income, wealth, and innovation, as measured by the number of new patents. But just as the coffeehouse is a pale comparison to the city, the city is a pale comparison to the World Wide Web. And this meta-intelligence continues to grow as more and more people come online.

One of the radical advantages of contemporary technology is "dematerialization," one of the benefits of miniaturization (a radical decrease in footprint size) for a great many items we use in our lives. **We're seeing the tip of the dematerialization wave**, like when a phone dematerializes a camera. It just disappears—like radios, televisions, recording studios, movie theaters, GPS navigators, stereos, flashlights, board games, card games, video games, a whole range of medical devices, maps, encyclopedias, dictionaries, translators, textbooks, world class educations, etc. with the ever-growing smorgasbord known as the app store. 10 years ago, most of

these goods and services were available only in the developed world; now just about anyone anywhere can have them. In summer 2011 the Android and Apple App store boasted 250,000 and 425,000 applications, respectively, with a staggering 20B downloads combined.

Today's greatest commodities aren't physical objects, they're ideas. Today the fastest-growing job category is the "knowledge worker," Since knowledge is nonrival, most of the jobs in the future will produce nonrival goods, and this removes another constraint on abundance: it allows the rising billion to earn a living in a way that does not require burning through our ever-diminishing supply of natural resources. Bio- and nanotechnology create products and services at the molecular level, holding the potential to completely eliminate waste and pollution.

Then there's also demonetization. eBay has demonetized transactions, putting local stores out of business, yet increasing the availability of goods while simultaneously reducing the cost. Craigslist has demonetized advertising, taking 99% of the profits out of the newspaper industry and putting them back into the pockets of the consumer. iTunes tanked the record store and liberated audiophiles. Goods and services once reserved for the wealthy few are now available to anyone equipped with a smart phone, which includes the rising billion. Energy poverty is the scourge of Africa, with poor-grade wood, dung, or crop waste to cook and light, with its exorbitant cost, toxic fumes, and environmental devastation. The new generation is led by fast-moving, entrepreneurial to snatch back the continent from the jaws of poverty, corruption, and poor governance—3 issues that could be changed significantly with more access to energy. More people die from smoke inhalation than from malaria. Indoor air pollution is linked to respiratory diseases such as pneumonia, bronchitis, and lung cancer. Women and children who spend long periods every day around traditional open fires inhale the equivalent of 2 packs of cigarettes a day. Because children have to help collect fuel during school hours, time spent on their education is severely reduced. Students need to do their homework but have no light for studying. Lack of energy also means people struggle to start simple businesses.

Africa is larger than the continental US, China, India, Japan, and all of Europe **combined** and it could become energy independent, with the biggest opportunity in the sun. It's decentralized, fully democratic, and available to all in great abundance. For the past 30 years every cumulative doubling of global Photo Voltaic production, costs have dropped by 20%. This is another of those exponential price-performance curves, now known as Swanson's law. With this glide-slope of costs, Italy and the US will achieve parity (the point when renewable become as cheap as traditional sources) in 2014 and 2017, re-

spectively. Solar prices are falling 5-6% annually, and capacity is growing at a rate of 30% per year. Generation IV nuclear technologies are much cheaper and safer than those now operating in most of the world. These are “passively safe”—meaning that in case of trouble, they’re able to shut themselves down without human intervention.

The best way for children to learn is not through instruction, but rather “construction”—that is, learning through doing, especially when the doing involves computers. Computers may be a way to bring a quality education to the 23% of the world’s children currently not in school. OLPC is an initiative aimed at providing every child on the planet with a rugged, low-cost low-power, connected laptop. **Everywhere OLPC goes, truancy drops.** Truancy isn’t exclusive to the Third World. On average, only 2/3 of American school students finish high school. In some areas, the dropout rate is over 50%; in Native American communities, it’s over 80%. About half of these people said they left school because their classes were boring and not relevant to their lives or career aspirations. 88% had passing grades at the time that they dropped out. Nearly ¾ of the interviewees said they could have graduated if they wanted to.

The industrialized model of education, with its emphasis on the rote memorization of facts, is no longer necessary. Facts are what Google does best. But creativity, collaboration, critical thinking, and problem solving—that’s a different story. These skills have been repeatedly stressed by everyone from corporate executives to education experts as the fundamentals required by today’s jobs. If boredom is the number one cause of truancy, then our new education system needs to be effective, scalable, and wildly entertaining. Studies have shown that **games outperform textbooks in helping students learn fact-based subjects such as geography, history, physics, and anatomy, while also improving visual coordination, cognitive speed, and manual dexterity.** For example, surgeons and pilots trained on video games perform better than those who were not. Some educators compare game play to the scientific method. Players encounter a phenomenon that doesn’t make sense, observe problems, form hypotheses, and test them while being mindful of cause and effect. **Soon we’re going to be able to create gamed-based learning that is so deep, immersive, and totally addictive** that we’re going to look back on the industrial model and wonder why it ever hung around for so long. This lets teachers personalize education, trading their sage-on-a-stage role for that of a coach. Students work at their own pace and advance to the next topic only once they have thoroughly learned the last. Games take testing, the most painful part of school, and make it fun. Even better is the data-capturing ability of video games, which can collect fine-grain feedback about student progress moment by moment, literally

measuring growth every step of the way. Early versions of always-on **AI tutors have raised math scores a staggering amount, some increasing middle school pass rates from 20% to over 90%.**

Freedom falls into a different category. It’s both ideas and access to ideas, including economic freedom, human rights, political liberty, transparency, the free flow of information, freedom of speech, and empowerment of the individual. **Tools of prosperity do double duty as crusaders for liberation: freeing up time and money, improving quality of life, and creating even greater opportunity for opportunity.**

4 major motivators drive innovation: 1) Curiosity 2) Fear. The ratio of fear to curiosity is the ration of the defense budget to the science budget (\$700B/\$30B in 2011). 3) Desire to create wealth, exemplified by the growth of venture capital. 4) Desire for significance. One tool that harnesses all of these motivators is called the incentive prize. Incentive competitions have a biological advantage. Humans are wired to compete. Large incentive prizes raise the visibility of a particular challenge while helping to create a mind-set that this challenge is solvable. After the Ansari X PRIZE for space travel was won, a half dozen companies were formed, nearly \$1B invested, and hundreds of millions of dollars’ worth of tickets for carriage into space have been sold. In areas where market failures have hindered investment or entrenched incumbents have prevented progress, prizes break bottlenecks. Incentive prizes also cast a wide net. Everyone from novices to professionals to massive corporations gets involved. After the Wendy Schmidt Oil Cleanup X CHALLENGE (following the BP spill in 2010), some 350 potential teams from over twenty nations preregistered for the competition. Because of the competitive framework, people’s appetite for risk increases, which further drives innovation. The sporting atmosphere lures legacy-craving, wealthy benefactors and corporations looking to distinguish themselves in a media-cluttered environment. The prize money defines spending parameters, but this perceived upper limit tends to keep out risk-adverse traditional players. A clear, bold target for the competition is the next important restriction. The Archon Genomic X PRIZE challenges teams to sequence 100 human genomes accurately (1 error/1M base pairs), completely (98% of the human genome), rapidly (within 10 days), and cheaply (at a cost of less the \$1000/genome)—a quadruple combination that’s a 365M price-to-performance improvement over Venter’s original 2001 work.

Before the average American earns \$75,000 a year, there is a direct correlation between money and happiness. Above that numbers, the correlation disappears. The typical American spending breakdown show that 75% of the money we earn goes to meet basic needs versus over 90% in most developing countries.

<http://www.AbundanceHub.com> is a site for a free newsletter on this subject.

[Perhaps God's common grace and the coming of His kingdom can be seen in the narrative of growing abundance. The 20th century saw a global infant mortality decrease of 90%, a maternal mortality decrease of 99%, and human lifespan increase of more than 100%. The key to population growth is to improve health. There is a strong correlation, as you improve health, within half a generation, the population growth rate goes down. The impact of the mobile phone in Africa has had about the same effect as a democratic change of leadership. Heuristics are cognitive shortcuts. Once the amygdala begins hunting bad news, it's mostly going to find bad news. It's hard to be optimistic, because the brain's filtering architecture is pessimistic by design. Poverty was reduced more in the past 50 years than in the previous 500. Time saved

is proportional to the division of labor. Small groups of dedicated DIY innovators can now tackle problems that were once solely the purview of big governments and large corporations. We're seeing the tip of the dematerialization wave. Everywhere OLPC goes, truancy drops. Games outperform textbooks in helping students learn fact-based subjects such as geography, history, physics, and anatomy, while also improving visual coordination, cognitive speed, and manual dexterity. Soon we're going to be able to create gamed-based learning that is so deep, immersive, and totally addictive. AI tutors have raised math scores a staggering amount, some increasing middle school pass rates from 20% to over 90%. Tools of prosperity do double duty as crusaders for liberation: freeing up time and money, improving quality of life, and creating even greater opportunity for opportunity.]