



## Gerd Leonhard

Dear friend, as a fellow human being I invite you to take part in what might be the most important conversation our planetary tribe will ever have - *Technology vs. Humanity*.

Whatever your personal viewpoint may be on the sliding scale from passionate transhumanist to old-world Cassandra, now is the time to join in and have your speak on the essentials worth living - or even evolving - for.

Start reading and join now  
this important emerging conversation.

### How will humanity prevail in the face of rapid and all-encompassing technological change?

Our world is entering a period of truly transformative change, and many of us will be surprised by the scale and pace of developments we simply hadn't anticipated. Tremendous potential lies in these [exponential](#) technological advances, yet with these new opportunities also come tremendous new responsibilities. An avalanche of technological changes will reshape the very essence of humanity and touch every aspect of life of our planet.

In the past, each radical shift in human society has been driven primarily by one key enabling shift factor - from wood, stone, bronze and iron to steam, electricity, factory automation and the Internet. Today, however a set of science- and technology-enabled [Megashifts](#) are coming together that will redraw, not only commerce, culture and society but also our biology and our [ethics](#).

Let me be clear about this book: *Technology vs. Humanity* is neither a celebration of the rapidly onrushing technology revolution nor a lament on the fall of civilization. If, like me, you're a movie buff, then you've probably already had more than enough of Hollywood's utopian visions and dystopian warnings. The future will not be created based on fear!

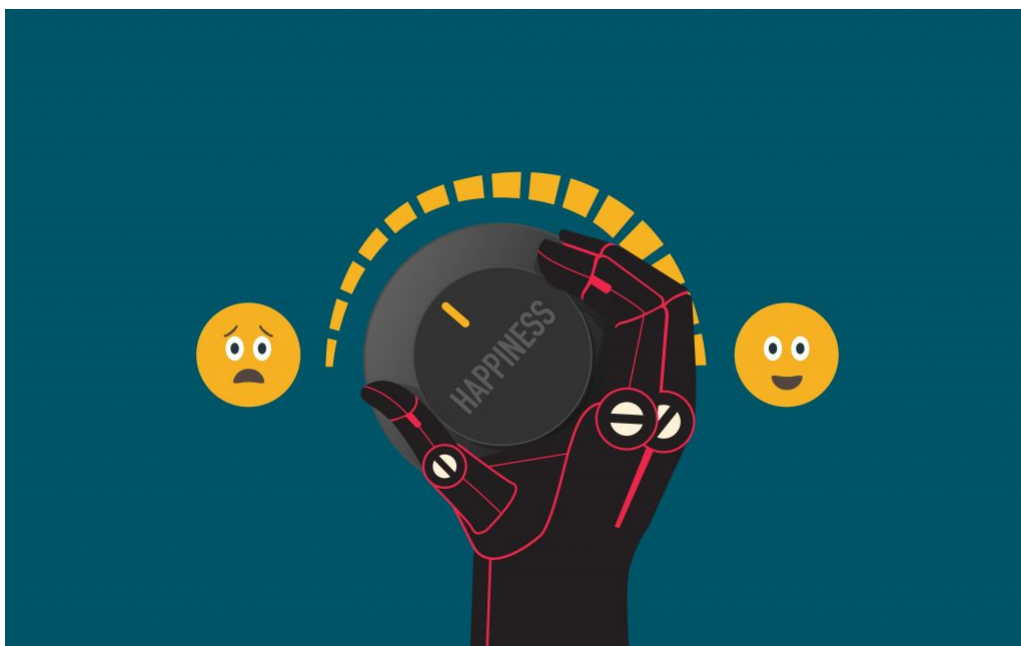
My goal with this book is to amplify and accelerate the debate about how to can guide, harness and control the development of science and technology so that they fulfil their primary purpose, which is to serve humanity, and to further human flourishing.

My ambition is to take the discussion way beyond the realms of the exuberant technologists or thoughtful analysts and academics to express a set of concerns that are nowhere near to being addressed or even recognized by the population at large. As a [futurist](#) - and increasingly more of a [nowist](#) - I am also hoping to give real presence and current urgency to a future that still seems beyond comprehension and unworthy of attention for many.

As such, this book is deliberately designed to be a passionate discussion starter for what I believe to currently be the world's most important conversation. I believe my role here is to open up and catalyze the debate, hence I have set out to craft a spirited manifesto rather than a guidebook. In the future, many of my [talks](#), [keynotes](#) and [films](#) will expand on the themes outlined in the book, as well.

We need to step back from an expert debate about what's possible and how to achieve it, and start with a more fundamental exploration of what role we want these transformative technologies to play in serving humanity: just because we can, it doesn't mean we should.

In the book, I have set out what I believe to be the driving forces of change, and present an assessment of their potential impacts and implications. I have highlighted many fundamental questions raised by the accelerated - and in many cases exponential - pace of development across multiple fields of science and technology. I argue to place human happiness and wellbeing at the heart of the decision-making and governance processes that will shape future investments in scientific and technological research, development and commercialisation - because in the end, [technology is not what we seek](#), but how we seek.



## A PROLOGUE TO THE FUTURE

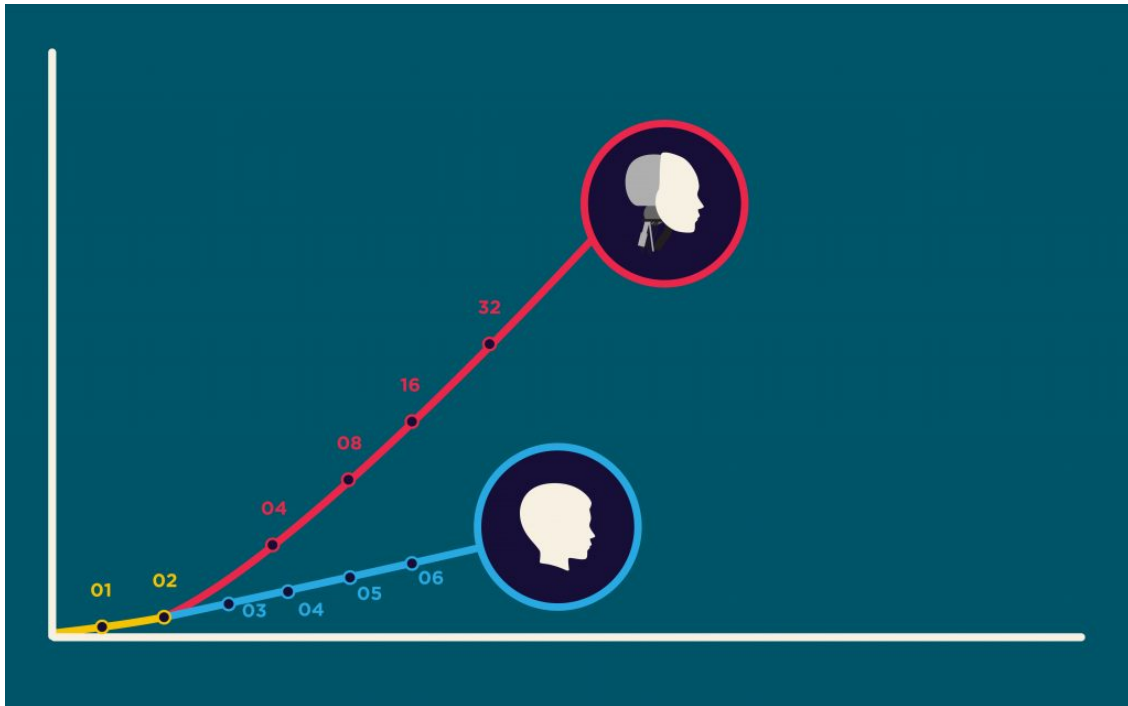
### Humanity will change more in the next 20 years than in the previous 300 years

Human beings often extrapolate the future from the present, or even the past. The [assumption](#) is that whatever worked well for us up to now should in some slightly improved shape or form also serve us nicely in the future. Yet the new reality is that because of the increased impact of exponential and combinatorial technological changes (as I will explain throughout this book) the future is actually very unlikely to be an extension of the present. Rather, it is certain to be utterly different - because the framework and the underlying logic has changed. Therefore, in my work as a futurist I try to intuit, imagine and immerse myself in the near-future (5-8 years) and then work my way back from there rather than towards it.

This book is both a report from that future and a kind of manifesto, a passionate call to stop and think before we all get swept up in the magic vortex of technology, and eventually become less rather than more human. Right now is a good time to remember that the future does not just happen to us - it is created by us, every day, and we will be held responsible for the decisions we make at this very moment.

I feel that we are living in one of the most exciting times in the history of mankind, and I am generally very optimistic about the future. However, we definitely need to define and practice a more holistic approach to technology in order to safeguard the very essence of what being human means.

We are at the inflection point of an [exponential curve](#) in many fields of science and technology, a point where the doubling from each measurement period to the next is becoming vastly more significant (see [Moore's Law](#)). This exponential pace of development is now evident everywhere including in fields such as deep learning, genetics, material sciences and manufacturing. The time required for each exponential performance step is also declining in many fields, and this is driving the potential for fundamental change across every activity on the planet. In practical terms, we are now past the stage in the life of the curve where it was difficult to gauge that something is happening, at all, i.e. we are no longer moving in small steps from 0.01 to 0.02 or 0.04 to 0.08.



At the same time, fortunately, we are not yet at the point where those doublings are so great that the results will overwhelm our understanding and inhibit our capacity to act. To put things in perspective, in my view we are at a relative performance level of around four in most fields, and the next exponential step will take us to eight, rather than a more linear rise to five! This is the very moment when exponential increases are starting to really matter, and technology is now driving exponential changes in every sector of our society, from energy, transportation, communications and media, to medical, health, food and energy.

Witness the recent changes in the car industry - during the past seven years we've gone from electric cars with a range of less than 50 miles to the latest Tesla and BMWi8 promising over 300 miles on a single charge. We've also gone from a handful of charging locations to the astounding fact that New York City already has more electric vehicle (EV) charging stations than gas stations. Nearly every month there's a new breakthrough in battery efficiency, a limitation which has for the past decades been one of the biggest barriers to mass adoption of electric vehicles. Soon we'll charge our EVs just once a week, then once a month, and eventually once a year - and very few people will still be interested in huge luxury cars with good old gas engines!

Witness the even more dramatic cost decline in human genome sequencing, with the price falling from around \$10 million in 2008 to approximately \$800 today. Imagine what might happen when exponentially more powerful supercomputers move into the cloud and become available to every medical facility or lab: the cost of sequencing an individual's genome should quickly drop below \$50. Next, imagine the genome profiles of some 2 Billion people uploaded to a secure cloud (hopefully in an anonymized way!) for use in research, development and analysis - much of it performed by [artificial intelligence](#) (AI) running on those very same supercomputers. The scientific possibilities that will be unleashed will blow away anything we have dreamed of while simultaneously bringing enormous ethical challenges: dramatic longevity increases for those that have the budget, the ability to re-program the human genome, and—potentially—the end of ageing, or even dying. Will the rich live forever while the poor still can't even afford malaria pills?

Such **exponential developments** suggest that continuing to imagine our future in a linear way will probably lead to catastrophically flawed assumptions about the scale, speed and potential impacts of change. That may be part of the reason why so many people cannot seem to grasp the growing concerns about technology trumping humanity—it all seems so far away, and, for now, rather harmless because we are only at four on this curve. Issues such as the increasing loss of privacy, technological **unemployment** or human de-skilling are still not in-our-face enough - but this is bound to change very quickly!

It is also important to realize that the biggest shifts will happen because of combinatorial innovation, i.e. by exploiting several of the megashifts (as explained in chapter 4) and elements of disruption at the same time. For example, we are increasingly seeing companies combining Big Data and the **Internet of Things (IoT)** concepts along with AI, mobility, and the cloud to create extremely disruptive new offerings (see chapter 4 on Megashifts).

Suffice to say that nothing and no one will be untouched by the changes in store for us, whether they are realized with good will, while ignoring or neglecting to consider the unintended consequences, or with harmful intent. On the one hand, unimaginable technological breakthroughs may dramatically improve our lives and hugely further human flourishing (see chapter 10, on happiness and for what exactly flourishing may mean in the future). On the other hand, some of these exponential technological changes are quite likely to threaten the very fabric of society, and ultimately question our very humanness.

In 1993, computer scientist (and famed science fiction author) Vernor Vinge wrote: *Within 30 years, we will have the technological means to create superhuman intelligence. Shortly after, the human era will be ended. Is such progress avoidable? If not to be avoided, can events be guided so that we may survive?*



## Welcome to HellVen!

It is quickly becoming clear that the future of man-machine relations very much depends on the economic system that creates them. We are facing what I like to call [HellVen](#) (i.e., a blend of hell/heaven) challenges ([#hellven](#)). We are moving at warp speed towards a world that on the one hand may resemble Nirvana, where we may no longer have to work for a living, most problems are solved by technology, and we enjoy a kind of universal abundance—sometimes referred to as the '[Star Trek economy](#)'

Or on the other hand, the future could usher in a dystopian society that is orchestrated and overseen by supercomputers, networked bots and super-intelligent software agents—machines and algorithms, cyborgs and robots - or rather, by those who own them; a world where non-augmented humans might be tolerated as pets or as a necessary nuisance at best, or enslaved by a cabal of cyborg gods at worst; a dark society that would be de-skilled, de-sensitized, disembodied, and altogether de-humanized.

*“You may live to see man-made horrors beyond your comprehension.”— Nikola Tesla*

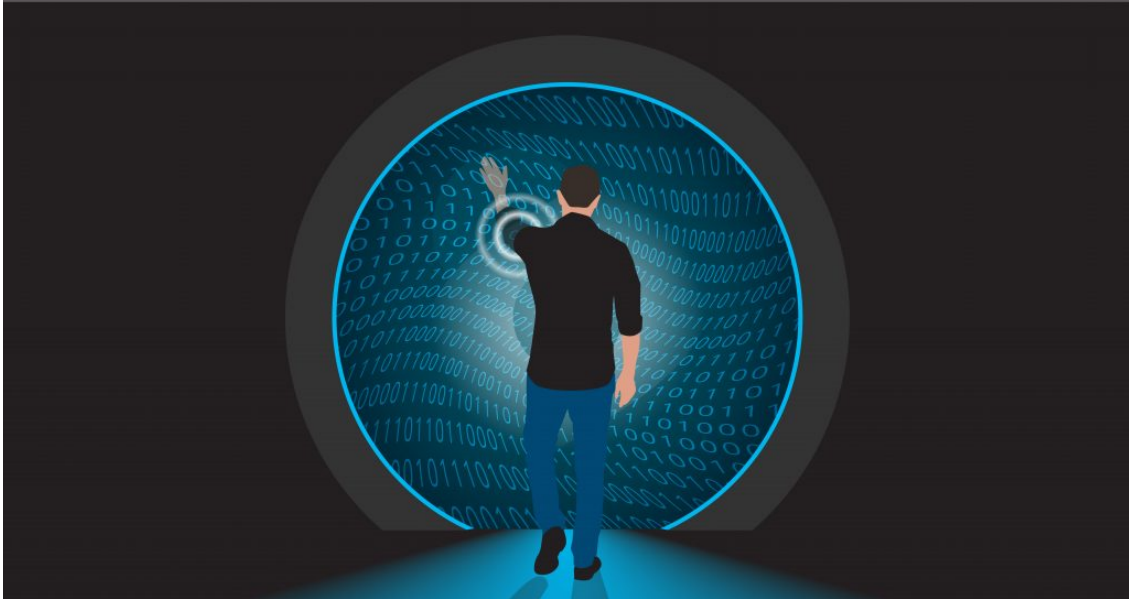
Is this a paranoid view?

Let's consider what some of us are already witnessing in our daily lives: low-cost, ubiquitous digital technologies have made it possible for us to outsource our thinking, our decisions, and our memories to ever-cheaper mobile devices and the intelligent clouds behind them. These 'external brains' are morphing quickly from knowing-me to representing-me to being-me. In fact, they are starting to become a digital copy of us - and if that thought is not worrying you yet, imagine this amplified 100x in the next 5 years.

Navigating a strange city? Impossible without Google Maps. Can't decide where to eat tonight? TripAdvisor will tell me. No time to answer all my emails? Gmail's new intelligent assistant will do it for me.

As far as [man-machine convergence](#) is concerned, we're not quite in a world where we stay at home while our cyborg doubles live out our lives for us, as in the 2009 Bruce Willis film *Surrogates*. Nor are we yet able to purchase human-like synths that can undertake a range of tasks and provide companionship as in the 2015 AMC TV series *Humans* - but we're not that far away, either.

## HUMANITY AND TECHNOLOGY ARE CONVERGING



In this book I will explain why I do not think the dystopian scenario is likely to happen. At the same time, I will argue that we are now facing some fundamental choices when it comes to deciding and planning how far we will allow technology to impact and shape our lives, the lives of our loved ones, and the lives of future generations. Some pundits may say we already are beyond the point of preventing such changes, and that this is just the next stage in our 'natural' evolution. I strongly disagree and will explain how I think humans can emerge as winners in this coming clash between man and machines.

### **Technology and humanity are converging, and we are at a pivot point**

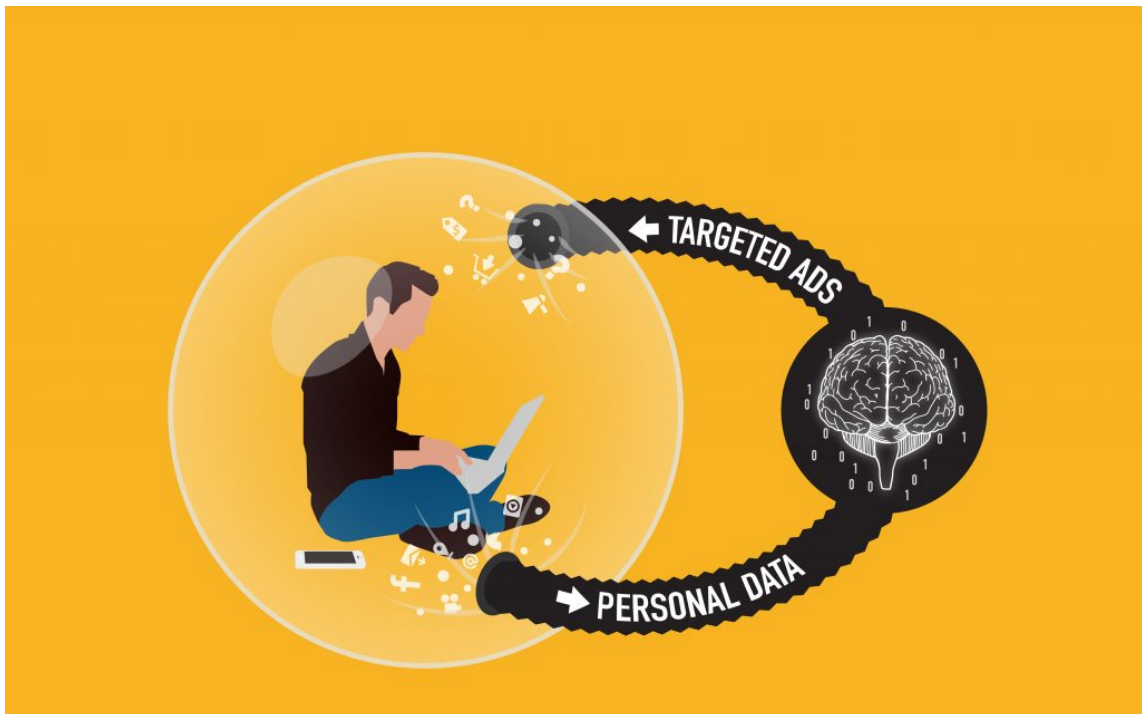
As I started writing this book and weaving the themes into my talks, three important words rose to the top and stood out - exponential, combinatorial and recursive.

1. Exponential. Technology is progressing exponentially. Even though the basic laws of physics may prevent microchips from becoming significantly smaller than they already are today, technological progress in general is still following Moore's Law. The performance curve continues to rise exponentially, not in the gradual or linear way humans tend to understand and expect. This represents a huge cognitive challenge for us: Technology grows exponentially, while humans (hopefully, I would add) remain linear.

2. Combinatorial. Technological advances are being combined and integrated. Game-changing advances such as machine intelligence and deep learning, the Internet of Things (IoT), and human genome editing are beginning to intersect and amplify each other. They are no longer applied just in specific individual domains - instead they are causing ripples across a multitude of sectors. For example, advanced human gene editing technologies such as CRISPR-Cas9 may eventually allow us to beat cancer and dramatically increase longevity. These are developments that would upend the entire logic of medical care and health, social security, work, and even capitalism itself.

3. Technologies such as AI, cognitive computing, and deep learning may eventually lead to **recursive** (i.e., self-amplifying) improvements. For example, we are already seeing the first examples of robots that can reprogram or upgrade themselves or control the power grid that keeps them alive, potentially leading to what has been called an intelligence explosion. Some, such as Oxford academic Nick Bostrom believe this could lead to the emergence of super-intelligence – AI systems which could one day learn faster, and out-think humans in almost every regard. If we can engineer AIs with an IQ of 500, what would keep us from building other ones with an IQ of 50,000 – and what would happen if we did?

Thankfully, recursive super-intelligence is not yet on the immediate horizon. However, even without such challenges, we are already grappling with some rapidly escalating issues, such as the constant tracking of our digital lives, surveillance-by-default, diminishing privacy, the loss of anonymity, digital identity theft, data security, and much more. That is why I am convinced the groundwork for the future of humanity—positive or dystopian – is being laid here, today.



We are at a crucial junction, and we must act with much greater foresight, with a decidedly more holistic view, and with much stronger stewardship as we unleash technologies that could end up having infinitely more power over us than we could ever imagine.

We can no longer adopt a wait-and-see attitude if we want to remain in control of our destiny and the developments that could shape it. Rather, we must pay equally as much attention on what it will mean to be or remain human in the future (what defines us as humans) than what we spend on developing infinitely powerful technologies that will change humanity forever.

We should take great care to not just leave these decisions to ‘free markets’, to venture capitalists, corporate technologists, or the world’s most powerful military organizations. The future of humanity should not be about some generic, industrial-age paradigm of profit and growth at all costs, or some outmoded technological imperative that may have served us



well in the 1980s. Neither Silicon Valley nor the world's most powerful nations should end up becoming 'mission control for humanity' just because it generates new revenue streams.

Thankfully, I believe we are still at the 90/10 point right now: 90% of the amazing possibilities presented by technology could play out well for humanity, and 10% might already be troublesome or negative. If we can maintain that balance, or bring it up to 98/2, that would be worth every effort. At the same time, that troubling 10% (even if mostly unintended at this time) may quickly balloon to 50% or more if we do not agree on exactly how we want these technologies to serve humanity - this is clearly not a good time to just push ahead and see what happens.

## Artificial intelligence and human genome editing are the two primary game changers.

The first major force in the realm of exponential technologies is AI, simply defined as creating machines (software or robots) that are intelligent and capable of self-learning—i.e., more human-like thinking machines. The capability of AI is widely projected to grow twice as fast as all other technologies, exceeding Moore's Law and the growth of computing power, in general.

*"By far the greatest danger of Artificial Intelligence is that people conclude too early that they understand it." —Eliezer Yudkowsky*

The companion game changer to AI is [human genome engineering](#); altering human DNA to put an end to some if not all diseases, re-program our bodies and possibly even end death.

These two game-changers, and their neighbors, will have huge impact on what humans can and will be in less than 20 years.

## Becoming as God?

Dr. Ray Kurzweil, currently Google's Director of Engineering, is a great influence on every futurist and on my work, as well, but someone who nevertheless I must often contradict in this book. [Kurzweil](#) predicts that computers will surpass the processing power of a single human brain by 2025, and that a single computer may match the power of all human brains combined by 2050.

Kurzweil suggests these developments will herald the advent of the so-called Singularity, the moment when computers finally trump and then surpass human brains in computing power. This is the moment when human intelligence may become increasingly non-biological, when it may be possible for machines to independently and quite likely recursively go beyond their original programming - a decisive moment in human history.

Ray Kurzweil told his audience at Singularity University in late 2015: *"As we evolve, we become closer to God. Evolution is a spiritual process. There is beauty and love and creativity and intelligence in the world—it all comes from the neocortex. So we're going to expand the brain's neocortex and become more godlike"*

I also believe the point of computers having the capacity of the human brain is not far off, but - God or no God - unlike Dr. Kurzweil, I do not think we should willingly give up our humanness in return for the possibility of attaining unlimited non-biological intelligence. That strikes me as a very bad bargain, a downgrade rather than an upgrade, and in this book I will explain why I passionately believe we should not go down that road.

Right now, in 2016, computers simply do not have the power, the chips are still too big, networks still do not have the speed, and the electricity grid by and large cannot support machines that would need this much power. Obviously, these are temporary hurdles: almost every day brings announcements of major scientific breakthroughs, and in addition numerous unpublicized advances are certain to be happening in secret labs around the world.

We need to be ready for the Singularity: open yet critical, scientific yet humanistic, adventurous and curious yet armed with precaution, entrepreneurial yet collectively-minded.

## Science fiction is becoming science fact

Very soon, machines will be able to do things that once were the sole domain of human workers—blue collar and white collar alike—such as understanding language, complex image recognition, or using our body in highly flexible and adaptive ways. By then, we will no doubt be utterly dependent on machines in every aspect of our lives. We will also likely see a rapid merging of man and machine via new types of interfaces such as augmented reality, virtual reality and holograms, implants, brain-computer interfaces and body parts engineered with nanotechnology and synthetic biology.

If and when things such as nanobots in our bloodstream or communications implants in our brains become possible, who will decide what is human? If (as I like to say) technology does not (and probably should not) have [ethics](#), what will happen with our norms, social contracts, values, and morals when machines run everything for us?

For the foreseeable future, machine intelligence will not include emotional intelligence or ethical concerns, that much is certain, because machines are not beings - they are duplicators. Yet eventually, machines will be able to read, analyze and possibly understand our value systems, social contracts, ethics and beliefs—but they will never be able to EXIST in, or BE a part of the world as we are (what German philosophers call [Dasein](#)).



Nevertheless, will we live in a world where data and algorithms triumph over what I call androrithms, i.e., all that stuff that makes us human? (yes, I will define exactly what I believe an androrithm is later in this book - for now, see what I wrote in the past few years on a similar term, humarithms, [here](#))

Again, doubling from 4 to add to 16 to 32 a whole lot different doubling from 0.1 to 0.2. This is one of our toughest challenges today: We must imagine an exponentially different tomorrow, and we must become stewards of a future whose complexity may well go far beyond current human understanding. In a way, we must become exponentially imaginative.

## Gradually, then suddenly

For me, this line from Ernest Hemingway's *The Sun Also Rises* describes the nature of exponential change perfectly: "How did you go bankrupt?" "[Two ways. Gradually, then suddenly.](#)"

When thinking about creating our future it is essential to understand these twin memes of exponentiality and 'gradually then suddenly', and both are key messages in this book. Increasingly, we will see the humble beginnings of a huge opportunity or threat. And then, all of a sudden, it is either gone and forgotten or it is here, now, and much bigger than imagined. Think of solar energy, digital currencies and the blockchain, or autonomous vehicles: All took a long time to play out, but all of a sudden, they are here and they are roaring. History tells us that those who adapt too slowly or fail to foresee the pivot points will suffer the consequences.

Wait and see is very likely going to mean waiting to become irrelevant, or simply to be ignored, outmoded and to wither away. Thus, we need another strategy for defining and retaining what makes us human in this quickly digitizing world.

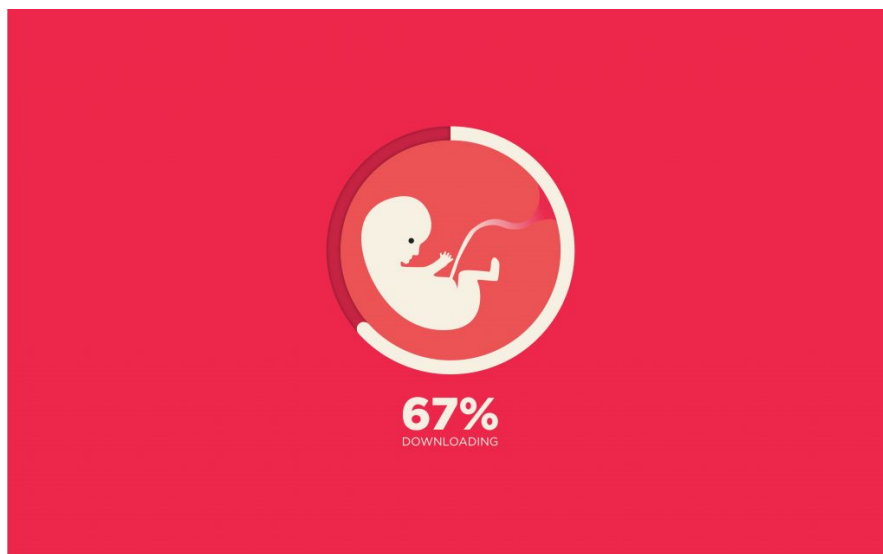
I tend to think that markets will not self-regulate and deal with these issues by means of some 'invisible hand'. Rather, traditional profit-and-growth-driven open markets will only escalate the challenges of humanity versus technology because these very same technologies are likely to generate opportunities worth trillions of dollars per year. Replacing human qualities, interactions or idiosyncrasies with technology is simply too much of a business opportunity to question. For example, [Peter Diamandis](#), a board member of [Human Longevity Inc.](#), often proclaims that increasing longevity would create a \$3.5 trillion global market. Irresistible new frontiers, indeed.

## Beyond mission control

In the end, we are talking about the survival and the flourishing of the human species, and I believe it just won't do to have venture capitalists, stock markets, and the military running the show on their own.

In the near future, we are certain to see some very tough battles between opposing world-views and paradigms with gigantic economic interests facing off against each other. For example, now that oil and fossil fuel is declining as the driving force of politics and military concerns, the US and China are at the forefront of an accelerating technological arms race. The new wars will be digital and the battle is being waged for leadership in exponential game changers such as AI, human genome modification, the IoT, cyber security, and digital warfare. Europe (including and especially Switzerland, where I live) is somewhat stuck in the middle, more concerned with what many would see as lofty issues such as human rights, happiness, balance, ethics, sustainable and collective well-being. As I'll explain, I believe addressing these concerns are actually our big opportunity here in Europe.

There are already global tribes of opinion leaders, serial entrepreneurs, scientists, venture capitalists, and assorted tech gurus (and yes, futurists as well) busy promoting a voluntary departure from humanism altogether. These techno-progressives are urging us to '[transcend humanity](#)' and embrace the next step in our evolution—which is, of course, to merge biology with technology, to alter and augment our minds and bodies and, in effect, become superhuman, ending disease (good) and even death (an alluring yet bizarre quest, in my opinion).



Interest in this notion of transhumanism is on the rise, and to me it is one of the most troubling developments I have observed in my 15 years of being a futurist. In my view, it is a rather delusional idea to try and achieve human happiness by seeking to transcend humanity altogether through technological means.

For context, here are two contrasting positions on transhumanism, as laid out by Transhumanism advocate and 2016 US Presidential Candidate Zoltan Istvan and the philosopher [Jesse I. Bailey](#):

The Protagonist Zoltan Istvan writes in his 2013 novel [The Transhumanist Wager](#):

*The bold code of the transhumanist will rise. That's an inevitable, undeniable fact. It's embedded in the undemocratic nature of technology and our own teleological evolutionary advancement. It is the future. We are the future, like it or not. And it needs to [be] molded, guided, and handled correctly by the strength and wisdom of transhumanist scientists with their nations and resources standing behind them, facilitating them. It needs to be supported in a way that we can make a successful transition into it, and not sacrifice ourselves—either by its overwhelming power or by a fear of harnessing that power. You need to put your resources into the technology. Into our education system. Into our universities, industries, and ideas. Into the strongest of our society. Into the brightest of our society. Into the best of our society. So that we can attain the future.*

The Humanist: challenging this position, Bailey writes in *The Journal of Evolution and Technology*:

*I argue that by threatening to obscure death as a foundational possibility for dasein [human existence], transhumanism poses the danger of hiding the need to develop a free and authentic relation to technology, Truth, and ultimately to dasein itself. Transhumanists often make one of two claims: Either the body we inhabit now will be able to live for hundreds of years or our consciousness will be downloadable into multiple bodies. Either of these positions (in subtly, but importantly, different ways) alienates human experience from central aspects of the finitude of embodiment. Heidegger locates being-toward-death as central to the call to authenticity, and away from lostness in the they-self (for whom technological enframing holds sway); by threatening our awareness of our own mortality, transhumanism thus threatens to occlude the call to authenticity, just as it occludes the need for it. (Via *The Journal of Evolution and Technology*, Vol. 24, Issue 2, July 2014, pp. 44-62.)*

To me, it is clear that technological determinism is not the solution and that the prevailing Silicon Valley ideology that argues “Why don’t we just invent our way out of this, have loads of fun, make lots of money while improving the lives of billions of people with these amazing new technologies?” could prove to be just as lazy—and dangerous—as Luddism.

In respectful contrast to some transhumanists’ rather [Cartesian](#) or reductionist views of humanity’s future, this book will strive to outline a mindset and digital-age philosophy that I sometimes call exponential humanism. Through this philosophy, I believe we can find a balanced way forward that will allow us to embrace technology but not become technology, to use it as a tool and not as a purpose.

## To safeguard humanity's future, we must invest as much in humanity as we do in technology.

I believe that if we want a world that remains a good place for humans, with all our imperfections and inefficiencies, we must put significant resources (monetary and otherwise) into defining what a new kind of 'exponential humanism' may actually entail. It will not be enough to just invest into the technologies that promise to make us super-human as we ride on the shoulders of machines whose workings we don't even understand any more.

I worry that an exponential, unfettered and uncontrolled intelligence explosion in robotics, AI, bio-engineering, and genetics will eventually lead to a systematic disregard of some basic principles of human existence. Technology does not have ethics but a society without ethics is doomed.

This dichotomy is arising everywhere: pretty much everything that can be digitized, automated, virtualized, and robotized probably will be, yet there are some things we should not attempt to digitize or automate—because they define what we are as humans.

This book explores where exponential and converging technologies might take us in next ten years, highlights what is at stake, and explores what we can do about it today. No matter what your philosophical or religious persuasion, you will probably agree that technology has already entered our daily lives to such a pervasive degree that any further exponential progress will surely demand a new kind of conversation about where the advances are taking us, and why.

Just as technology is literally about to enter our bodies and biological systems, it is time for a tribal pow-wow.

Thanks for reading this manifesto, and I hope you become an active participant in this conversation.

Gerd Leonhard, Zürich, Switzerland, July 2016

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*Note: this text has been edited for pre-publication purposes and is not entirely identical with the actual book text.*