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TECHNOLOGY vs. HUMANITY



The coming clash between
man and machine

Gerd Leonhard

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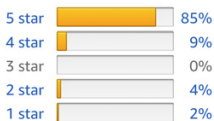
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Introduction

How can humanness prevail in the face of exponential and all-encompassing technological change?

Our world is entering a period of truly transformative change where many of us will be surprised by the scale and pace of developments we simply hadn't anticipated. These exponential technological advances offer tremendous potential, and with these opportunities come tremendous new responsibilities.

Humanity's biggest challenge

I believe the scale of change caused by recent, unforeseen events such as Brexit (the UK's June 2016 referendum decision to leave the European Union) will be miniscule compared to the impact of an avalanche of technological change that could reshape the very essence of humanity and every aspect of life on 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, I see a set of science and technology enabled Megashifts coming together that will redraw not only commerce, culture, and society, but also our biology and our ethics.

A manifesto for furthering human flourishing

Let me be clear: 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 film buff, then you've probably

already had more than enough of Hollywood's utopian visions and dystopian warnings. The future cannot be created based on blind optimism or paralyzing fear!

My goal with this book is to amplify and accelerate the debate about how to ensure that we guide, harness, and control science and technology developments so that they fulfill their primary purpose, which should be serving humanity and furthering human flourishing.

My ambition is to take the discussion beyond the realms of the exuberant technologists, serious academics, and thoughtful analysts 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 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 consider to 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 blueprint or “how to” guidebook. To help stimulate and further that debate, I will expand on the themes outlined in the book through my future talks, online contributions, and films.

Just because we can, it doesn't mean we should

I believe we need to step back from an expert-led debate about what's possible and how to achieve it. Instead, I think we must 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.

To help guide this exploration, I have set out what I believe to be the driving forces of change, and presented 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 that we must place human happiness and well-being at

the heart of the decision making and governance processes that will shape future investments in scientific and technological research, development, and commercialization because, in the end, technology is not what we seek, but how we seek.

I go on to present a range of different scenarios on how things might play out depending on the development path we take to the future. I conclude with a starter set of straw man ideas to kick-start discussions on how to choose the best path for humanity, and how to make good decisions along the way.

To open up this ambitious conversation and help guide the discussion, I have structured my thoughts into twelve key chapters:

Chapter 1: A Prologue to the Future – Halfway through the century's second decade we are at a critical pivot point in technology evolution, a hinge moment when change will not only become combinatory and exponential but inevitable and irreversible. Here I argue that now is our last chance to question the nature of these coming challenges, from artificial intelligence to human genome editing. Striking a balance will be the key.

Chapter 2: Tech vs. Us – In this chapter, I explain why technology may increasingly simulate and replace—but can never become or be us. Technology has no ethics, and therefore its imminent entry into our most private lives and biological processes must be negotiated as a top civic and corporate priority. I examine the nature of ethics as a human signifier and differentiator, transcending differences of religion and culture.

Chapter 3: The Megashifts – Digital transformation is being touted as the paradigm shift *du jour* across enterprises and the public sector—when in fact it is just one of ten Megashifts that will interact and alter the face of human life forever. I explore these Megashifts—from mobilization and automation to robotization. These are not slow evolutionary processes which we will have time to integrate and adapt to. Rather, they will trigger a tsunami of disruption and

change, potentially equating to a mass extinction event for much of the existing global commerce infrastructure.

Chapter 4: Automating Society – This chapter challenges the pervasive and seriously misleading myth that automation will only disrupt blue-collar—or even white-collar—labor. The coming wave of automation will move way beyond the factory or public infrastructure and into our very biological processes such as aging and even giving birth. Used as we are to the gradual societal shifts brought about by previous change waves, often allowing decades to adjust and respond, I ask if we as a tribe are ready to abdicate our human sovereignty to the faceless forces of technology? Are you ready for the biggest loss of free will and individual human control in history?

Chapter 5: The Internet of Inhuman Things – This chapter explores the potential challenges posed by the Internet of Things—the current dominant narrative within digital transformation, with thousands of corporate strategies riding on its tailwinds. Have we paused to ask ourselves the difference between algorithms and what makes us essentially human—what I call the androrithms? Will the Internet of Inhuman Things gradually and then suddenly require us to forgo our humanity and become ever more mechanistic just to remain relevant? As computing becomes mobile, then wearable, and soon ingestible or implantable, will our distinct planetary advantage as a species be sacrificed for a spurious digital hit?

Chapter 6: Magic to Manic to Toxic – Here I examine how our love affair with tech often follows a predictable curve from magic to manic to—ultimately—toxic. As we allow ourselves to experience life as an ever more mediated and processed sequence of encounters, we may think we are enjoying ourselves, but in reality we are simply being hot-wired by our hormones—hormones increasingly targeted by the gentle purveyors of “big tech.” As we rave through the all-night honeymoon party that is technological progress, it’s salutary to think about the hangover—the price to be paid tomorrow, and forever.

Chapter 7: Digital Obesity: Our Latest Pandemic – This chapter discusses how digital obesity may not be as currently familiar as the physical kind, but is rapidly developing into a pandemic of unprecedented proportions. As we wallow and pig out on a glut of news, updates, and algorithmically engineered information, we also entertain ourselves in a burgeoning tech-bubble of questionable entertainment. Taking into account the coming tidal wave of new technologies and digital engagement platforms, it's high time to think about digital nutrition just as we already do about bodily nurture.

Chapter 8: Precaution vs. Proaction – This chapter sets out the argument that the safest—and still most promising—future is one where we do not postpone innovation, but neither do we dismiss the exponential risks it now involves and hand it off as “somebody else’s problem.” The bill passed on to the next generation for today’s new technology gambles cannot be postponed—any downside will be immediate and unprecedented in scale. I argue that precaution and proaction, the two principles often deployed to date, are both insufficient to deal with a combinatorial, exponential scenario where waiting will be as dangerous as firing ahead. Transhumanism—with its lemming-like rush to the edge of the unknown—represents the scariest of all present options.

Chapter 9: Taking the Happenstance out of Happiness – Money talks, but happiness remains the bigger story. Happiness is not only considered the ultimate goal of human existence across philosophies and cultures, it also remains an elusive factor resistant to exact measurement or technological replication. As big tech simulates the quick hits of hedonistic pleasure, how can we protect the deeper forms of happiness that involve empathy, compassion, and consciousness? Happiness is also related to luck, to happenstance—but how will we use technology to limit the risks of human life and still preserve its mystery and spontaneity?

Chapter 10: Digital Ethics – In this chapter, I argue that, as technology permeates every aspect of human life and activity, digital ethics will evolve into a burning, un-ignorable issue for every individual and organization. At present we do not even have a common global language to discuss the issue, let alone agreement on accepted rights and responsibilities. Environmental sustainability is often brushed aside by the developing economies as a first world problem and is always sidetracked during economic recessions. In contrast, digital ethics will force its way to a permanent position at the front and center of our political and economic lives. It's time to have the ethical conversation about digital technology—a potentially greater threat to continued human flourishing than nuclear proliferation.

Chapter 11: Earth 2030: Heaven or Hell? – As we move imaginatively into the near and medium future, we can easily visualize some of the gigantic changes altering work and life out of all recognition—these are explored here. Many of these seismic changes are to be welcomed per se—like working for a passion rather than for a living. However, many of the most basic privileges we once took for granted, like freedom of choice in consumption and independent free will in lifestyle, could become vestigial echoes or the preserves of ultra high-net-worth individuals. Heaven or hell? Make your choice, but do it now.

Chapter 12: Decision Time – In this closing chapter I argue that it's crunch time for tech adoption—not the application of technology itself, but the deeper integration and delineation of technology in human life. Numerous ethical, economic, social, and biological issues will simply not wait for another forum or the next generation. It's time to regulate mass technology application just as we would any other transformational force such as nuclear power. This is not the conclusion of a rich dialogue, but the beginning of a conversation that needs to become mainstream in our media, our schools, our government, and—most immediately—our boardrooms. The time for technologists and technocrats to simply hand the ethical buck over to someone else has passed.

GERD LEONHARD

I hope that this book inspires you to think deeply about the challenges we face, and I invite you to contribute to this conversation by becoming a member of the techvshuman/TVH community at www.techvshuman.com.

Gerd Leonhard
Zurich, Switzerland
August 2016

Chapter 3

The Megashifts

Technological shifts are rewiring society and transforming the landscape.

I believe the coming clash between man and machine will be intensified and exponentialized through the combinatorial effects of ten great shifts—Megashifts, if you will, namely:

1. Digitization
2. Mobilization
3. Screenification
4. Disintermediation
5. Transformation
6. Intelligization
7. Automation
8. Virtualization
9. Anticipation
10. Robotization

As a paradigm change is to thinking and philosophy, so a Megashift represents a huge evolutionary step for society, one that may seem gradual at first . . . but then has a very sudden impact. Below I explore the nature of these Megashifts and then go on to describe each of them and their potential implications.

Exponential and simultaneous

Many of the world's great innovations were born decades, sometimes centuries, before they eventually swept through human society. They often occurred in a relatively sequential manner, each following and building on the previous ones. In contrast, Megashifts might grow slowly as well but many were born together. They have now started sweeping through society simultaneously and at a much faster pace.

Megashifts present immediate and complex challenges and differ in nature to the forces that have swept through society and business in the past. A key difference here is that a relatively few organizations and individuals that anticipate and find ways of exploiting or addressing a Megashift can normally expect to find opportunities and reap the biggest benefits. You may be familiar with these terms already, but now I want you to imagine them as distinct technological forces combining to create a perfect storm for humanity. Technostress? The challenges we have experienced so far won't even register on the stress scale when compared with what's to come...

Megashift 1: Digitization

Everything that can be digitized, will be. The first wave included music, then movies and TV, then books and newspapers. Now it is impacting money, banking, insurance, healthcare, pharmaceuticals, transportation, cars, and cities. Soon it will have transformational impact in logistics, shipping, manufacturing, food, and energy. It is important to note that when something gets digitized and moved to the cloud, it often becomes free or at least vastly cheaper. Consider what happened with Spotify: In Europe an individual 12-song CD used to cost around €20 (US\$22)—and now you can get 16 million songs for €8 (US\$9) per month, or listen to them free on YouTube.

While I am a happy and faithful Spotify subscriber and enjoy it very much, this kind of margin-destroying Digital Darwinism brings a huge shift in business models and forces most incumbents to transform or perish. In my 2005 book *The Future of Music* (Berklee Press), I discussed at length what seems to me a certainty—that the big record labels that controlled the music industry for decades will cease

to exist because distributing music is no longer a viable business.⁴⁶

Indeed, Sir Paul McCartney has famously compared incumbent record labels to dinosaurs wondering what happened after the asteroid.⁴⁷ While that is an accurate image of the “psychic whiplash” being experienced by the established rulers of this once lucrative kingdom, it gives no indication of the speed of extinction. Crocodiles survived and some dinosaurs evolved into chickens—but digital Megashifts pay little homage to history and take no prisoners.

In 2010, I coined the phrase “the people formerly known as consumers”; for them, digitization often means cheaper goods and widely improved availability.⁴⁸ That’s generally a positive, but then again, cheaper goods can also mean fewer jobs and lower wages. Witness the digitization of mobility with Uber and its rivals around the world like Lyft, Gett, and Ola Cabs in India. We can now order a taxi ride using an app on our smartphone, and it will often be cheaper than the incumbent competition. But will this economy work for the taxi drivers in the long term, or are we heading into a Darwinian “gig economy,” a situation where we all work a multitude of relatively poorly paid freelance gigs rather than regular jobs?⁴⁹

Regardless of societal challenges, the rapid digitization, automation, and virtualization of our world are probably inevitable. In practice, the rate may sometimes be constrained by fundamental laws of physics such as the hereto unmet energy needs of supercomputers or the minimum viable size of a computer chip—often cited as the reason why Moore’s Law will not prevail forever.

This assumption of continued and pervasive penetration of technology points towards a future where what cannot be digitized and/or automated (see Automating Society, chapter 4) could become extremely valuable. As discussed in chapter 2, these andrithms capture essential human qualities such as emotions, compassion, ethics, happiness, and creativity.

While algorithms, software, and artificial intelligence (AI) will increasingly “eat the world” (as venture capitalist Marc Andreessen likes to say),⁵⁰ we must place the same value on andrithms—those things which make us uniquely human.

As previously expensive products and services become cheap and abundant, algorithms must take center stage with technology if we are to remain a society that is concerned with human flourishing. We certainly would not want to go from software eating the world to software cheating the world!

For example, I foresee that in the near future we will see a shift in how organizations look at business metrics such as Key Performance Indicators (KPI)—a term widely used in business goal setting and human resources. Our future KPIs may no longer be built merely on counting and qualifying our professional achievements based on quantifiable facts and data such as unit sales, customer contacts, satisfaction ratings, or lead conversion ratios. Instead, we may see the rise of what I call Key Human Indicators, which will reflect a much more holistic and ecosystemic approach to gauging people's contributions. It is not the quantified employee but the qualified human that we should be pursuing!

As with all the Megashifts, digitization is both a blessing and a curse and, either way, it is not something we can just switch off or delay significantly—therefore, it is imperative that we prepare accordingly.

Megashift 2: Mobilization and mediazation

Computing is no longer something we do mostly on computers, and by 2020 even the idea will seem utterly fossilized. Computing has become invisible and ingrained into our lives, piggybacking on what we used to call mobile telephones. Connectivity is the new oxygen, while computing is the new water. Both next-to-limitless connectivity and computational capability will become the new normal.

Music is mobile, movies are mobile, books are mobile, banking is mobile, maps are mobile . . . the list keeps growing. Mobilization also means that technology is moving much closer to (and soon, into) us—from the desktop into my hand or onto my wrist via wearable devices such as watches, then onto my face as augmented reality (AR) or virtual reality (VR) glasses or contact lenses, and soon directly in to my brain through brain-computer interfaces (BCI) or implants. As Gartner suggests, sync me, know me, track me, see me, hear me,

understand me . . . be me—that's where mobilization is taking us.⁵¹

"There will come a time when it isn't 'They're spying on me through my phone' anymore. Eventually, it will be 'My phone is spying on me.'" –Philip K. Dick⁵²

Cisco predicts that by 2020, almost 80% of the world's Internet traffic will come via mobile devices, which will handle almost everything that used to be done only on desktops.⁵³ That is already the case when looking at roles as diverse as graphic designers, telecom engineers, and logistics service planners and providers. And much of it will be done by voice, touch, gesture, or AI—no more typing!

The rapid rise of digitization and mobilization has also resulted in the mediatization (recording) of everything as well as the datafication of information, where things once held in analog form as non-data—such as medical information shared in conversation with my doctor—have migrated onto the cloud as electronic records. Much of what used to be shared and experienced without much use of technology, in actual person-to-person interactions, is now being captured, filtered, or transmitted on smart devices with powerful screens.

Images and memories that we historically stored only in our biological hippocampus are now routinely vacuumed up by mobile devices and shared online at a rate of over two billion images per day.⁵⁴ Deloitte Global projects that, collectively, people will share over one trillion images online in 2016.⁵⁵

News that used to be printed is now streamed through apps, becoming liquid and malleable. Social dating that used to get started in cafes and bars is now facilitated through a few swipes on an app. Restaurants that used to be discovered through the private recommendations of good friends are now identified through online rating engines that provide user reviews and websites offering 360° views of their kitchens (and the food!). Medical advice used to require local nurses and doctors—now it is delivered via devices that promise a better medical diagnosis right from your home for a fraction of the cost. Scanadu is a remote diagnosis device that measures your

vitals—including your blood—and connects to the cloud for an instant analysis.⁵⁶ Many experiences that used to arrive through person-to-person communications are now becoming media.

The bottom line is everything that can be mobilized probably will be, but not every mobilized experience should be media-ized as a consequence.

We must consider the possibility that the prevailing technological imperative of “doing it because we can” may no longer be a clever move. Exponential technological advances will enable us to do much larger and more complex tasks, including activities that will have material impact on our behavior and our experiences as humans—and not always in a positive manner.

Consider, for example, the previously unrealistic possibility of tracking every single person who uses the Internet via their mobile gadgets. Yes, our “always on” devices have the benefits of total connectivity and constant activity monitoring via our health-tracking apps and step-counting devices. However, we will also become exceedingly trackable, naked, predictable, manipulated, and ultimately . . . programmable.

Here are some critical questions we should ask ourselves when determining the extent to which we want technology to intervene in our human experiences:

- Do we really need to photograph or record everything around us in order to create a complete “machine in the cloud” memory of our lives?
- Do we really need to share every aspect of our lives on digital platforms and social networks? Does that make us look (and feel) more like machines or more like humans?
- Do we really need to rely on live, real-time translation apps such as SayHi or Microsoft Translate to converse with someone in another language? Admittedly that can be quite useful when in a tight spot, but it also puts yet another media/device barrier between us and other people; it media-izes a uniquely human

process. Here again, it is about a new balance we will need to strike, not just about a yes/no answer.

Megashift 3: Screenification and interface (r)evolutions

From type to touch and talk, almost everything that used to be consumed as print on paper is now migrating to a screen. These interface (r)evolutions mean that newspapers are very likely not going to be read on paper at all within just ten years. The same fate, no doubt, will overtake magazines, but somewhat more slowly, because most magazines are also about the sensations of touch and scent. They are just more experiential in the raw that way.

Paper maps are already moving to devices and will likely disappear almost completely in a few short years. Banking used to be done in buildings or at automated teller machines; now it is going mobile and into the cloud at a frantic pace. Phone calls used to be made with telephones; now they are becoming video calls conducted via screen services like Skype, Google Hangouts, and FaceTime.

Robots used to have buttons or remote controls as interfaces; now it's all about screens that are made to look like faces—and we just talk to them. Cars used to have switches, buttons, simple displays, or custom consoles; now car controls are fully-fledged touchscreens. And the list doesn't just go on—it's about to explode!

As even more powerful visual augmentation devices flood into the market, our eyes are also being screenified. Even though there are already people suggesting we should upgrade them with technology, in the near future, we will still see with our own Human 1.0 eyes. However, many of us may also use augmented eyeglasses, Internet-enabled contact lenses, or visors that dramatically enhance what we see and how we can respond to it. The way we see the world is about to change, forever—a true HellVen situation.

Screenification is a key trend in the convergence of human and machine and the growing debate over how far we should go with it. It paves the way towards widespread use of AR/VR and holograms.

We will have screens for everything, everywhere, and those screens, powered by solar energy and low cost, long-lasting batteries,

may well become cheaper than fancy wallpaper. Hence, it will be very easy to take the next step and use screens as overlays of our actual reality—to present information or other contextual images on top of what we actually see around us. Within ten years, I would venture that using AR and VR will become as normal as using WhatsApp is today. That is both an exhilarating and a scary thought: At that point, who is to say what is real and what is not?

Consider what that will do to our self-perception as human beings. Imagine attaining such “super-vision” and visual omnipotence just by wearing Microsoft’s US\$250 HoloLens visor. Imagine a doctor wearing a Samsung VR headset during the next surgery and lessening the risk of malpractice suits just because she has better access to live data.

The world we see might become infinitely richer, faster, and more interconnected—but how disorienting and addictive could that be? And why would one ever want to see anything without those new super-enhancers? This will become even more of an issue as the suppliers of these products inevitably deploy armies of neuroscientists and behavioral experts to tell them how to make our screens even more addictive and convenient. If you think a Facebook “like” already gets your dopamine going, then how much deeper could the visual high become?

“Here though, there are no oppressors. No one’s forcing you to do this. You willingly tie yourself to these leashes. And you willingly become utterly socially autistic. You no longer pick up on basic human communication cues. You’re at a table with three humans, all of whom are looking at you and trying to talk to you, and you’re staring at a screen! Searching for strangers in . . . Dubai!” –Dave Eggers, The Circle⁵⁷

Megashift 4: Disintermediation

A key trend in online commerce, media, and communication is to cut out the middle man or woman—disruption by going direct. This has already happened in digital music, where the newer platforms

like Apple, Spotify, Tencent, Baidu, and YouTube are disrupting and dislodging the record-label cartels that used to get 90% of an artist's earnings.

It's happening with tourism and hotels: Airbnb enables us to stay in private residences and book directly with the apartment owners, without the need for a traditional hotel.

It's happened in book publishing, where authors can now go direct with Amazon Kindle Publishing, getting up to 70% of the revenues on an eBook rather than 10% from a traditional publisher. Can you imagine the impact on the popularity and earnings of Tolstoy if he'd had that kind of direct access?

It's happening in banking transactions, where customers can now use tools like PayPal, M-Pesa in Africa, Facebook Money, and TransferWise to send payments around the globe. These services often bypass the banks and traditional money transfer services and the outrageous fees they presume to charge. Add retail, insurance, and soon energy to the equation and you can see where this is going: If it can be done direct and/or peer-to-peer, it will be. Technology is making it a certainty.

The key challenge is this: Disruption is great, disruption is exciting, disruption can be very lucrative—as evidenced by the much-hyped stories of startups achieving billion-dollar plus valuations in just a few years—but ultimately we also need construction.⁵⁸ On the surface, it seems fine to aim to join the ranks of firms with a valuation of US\$1 billion (unicorn) or US\$10 billion (decacorn). However, we need to go deeper to ensure we build something that creates a new and better infrastructure, as well as a societal context, not just something that has a high market capitalization, but adds nothing and simply takes away what used to be there.

Uber has disintermediated the taxi and limousine market, and that has been an amazing benefit to a lot of customers, as well as to the drivers and other Uber workers. However, in the process of becoming a very large and powerful player on this turf, Uber itself has become a new kind of intermediary. Some pundits are calling this “platform capitalism” and “digital feudalism” because of the way

Uber is treating its drivers as highly expendable commodities—a clear downside of the gig economy.⁵⁹

The Uber example shows that it will not be enough to simply take apart what is no longer working so well, such as the taxi industry, or to reboot services where current market incumbents just don't care enough anymore. It is also necessary to build a complete, new digitally native ecosystem that will take care of all pieces of the puzzle, not just some of them. Skimming the cream off the top after disrupting outmoded business models is not sustainable. It's not just about disruption. It's also about construction.

Disintermediation is clearly driven by the power of exponential technologies, and we will see a lot more of that. The biggest tsunamis of change will be in health and energy. It will be essential to remember that mere disruption will not work and will not last. We also need to build true human values and a holistic ecosystem that generates lasting value for everyone; not just more algorithms but also replenished androrithms. We must take a holistic view to really make a difference.

“Before you become too entranced with gorgeous gadgets and mesmerizing video displays, let me remind you that information is not knowledge, knowledge is not wisdom, and wisdom is not foresight. Each grows out of the other, and we need them all.” –Arthur C. Clarke⁶⁰

Megashift 5: Transformation

Going beyond mere change, the biggest meme in 2015 was “digital transformation,” a phrase that has already acquired the somewhat stale taste of “social media.” Nevertheless, the term is a good fit as it goes far beyond mere change or innovation. It literally means becoming something else, morphing from a caterpillar to a butterfly, or from a toy car to a toy robot, or indeed from a car manufacturer to a mobility provider. Transformation will be the number one priority for most companies and organizations as exponential technological change impacts them across the board. Transforming into what will

work five years from now requires a lot of foresight as well as courage, and naturally the support of all stakeholders and the capital markets.

But let's not forget that the mother of all transformations will be our own Megashift from being physically separate to being directly connected to computers and devices.

Megashift 6: Intelligization

This is a core reason why humanity is being challenged as deeply as it is: Things are becoming intelligent.

Every object around us that used to be disconnected and without dynamic context is now being connected to the Internet via sensor networks and continuously updated and interrogated via global device grids.

Whatever can be made intelligent will be because now we have the means.

Deep learning is a key enabler of intelligization, and it is a huge game changer. Rather than using the traditional approach of programming machines to follow instructions and get a job done, the emerging dominant paradigm is to give them nothing but massive processing power, access to huge amounts of legacy and real-time data, a base set of learning rules, and a simple command such as, "Figure out how to win every single GO, chess, or backgammon game." The machine then comes up with rules and strategies that we humans might never discover ourselves.

Google's DeepMind AI labs demonstrated the power of deep learning in 2015 by showing that a computer can actually learn how to play and win Atari computer games entirely by itself, and then evolve to total mastery in a very short time.⁶¹

Shortly after the Atari demonstration, DeepMind developed AlphaGo—a self-learning computer that mastered the ancient and infinitely more difficult Chinese game of Go.⁶² This is the holy grail of computer intelligence: Not the mathematical perfection that Deep Blue showed when it beat Gary Kasparov in chess,⁶³ but the capability for the machine to understand its surroundings and devise the best course of action itself—and recursively so. By repeatedly applying

the same process, these AIs may become exponentially better, very quickly.

Megashift 7: Automation

The great promise of many exponential technologies is that we can digitize everything, make it intelligent, and then automate and virtualize it. Automation is key to this idea of hyper-efficiency because it makes it possible to substitute humans with machines. I will address this Megashift in chapter 4 on the automation of society.

Megashift 8: Virtualization

Virtualization, simply put, is the idea of creating a nonphysical, digital version of something, rather than having a tangible copy of it on location. Some of the most commonly used virtual services are desktop or server virtualization, where my workstation is in the cloud and only accessed through a terminal on my desk or an app on my smartphone. Another example is communications and networking: Rather than using networking hardware such as routers and switches, calls and data communications are increasingly routed in the cloud using software-defined networking (SDN). The resulting benefits include potentially huge cost savings and faster service, but it is also disrupting the business models of huge global players such as Cisco.

Virtualization via cloud computing can, some suggest, deliver up to 90% cost savings.⁶⁴ Rather than shipping printed books around the globe, Amazon virtualizes the bookstore and sends digital files to readers on their Kindle reader. We are already on the verge of virtualizing shipping, too. Imagine the savings from a 3D printer that can produce your iPhone cover right in your living room; you just need to download the design. Imagine a future 3D printer that can print even the most advanced products with hundreds of composite materials, right there in your favorite mall, producing anything from tennis shoes to Barbie dolls to a myriad of products.

Decentralization is often a major component of virtualization because we do not need a central distribution point if a product can be provided in the cloud. SDN systems do not need all the cables to

run to a certain switch or box; all switching can be done remotely, allowing for significant savings. Naturally, security becomes a big issue when virtualizing or decentralizing assets because there are many fewer points of physical control.⁶⁵ That is a huge opportunity for innovative companies, but also a serious challenge for governments and politicians. How will we agree on the rules of engagement and the digital ethics behind the solutions to these technical challenges?

In the near future, virtualization will spread to all sectors such as banking, financial services, healthcare and pharmaceuticals—particularly in drug development. Digital therapeutics will aim to complement or even replace traditional medication by effecting behavioral modifications to reduce or even solve the same problem. Another powerful instance is cloud biology, where software ingests lab results and merges them with other data to help speed up the discovery of new drugs.

Now, imagine the exponential effect of combining the other Megashifts with virtualization. Virtualized cloud robots could make just about every process so much faster and more reliable, just as digitizing behavioral change may become an alternative to drugs.⁶⁶

Needless to say, virtualization will be a driving force in the conflict between technology and humanity, including the loss of jobs, the likelihood that “software will soon eat biology,” and the increasing temptation to virtualize humans via brain-uploading or cyborgism—the dream of many transhumanists.⁶⁷

Megashift 9: Anticipation

Computers are already becoming very good at anticipating our needs before we ourselves realize what they may be. Google Now and Google Home are intelligent digital assistants (IDAs) from Google, and a big part of the company’s huge bet on AI. They will anticipate any changes in your daily schedule—be it airline delays, traffic, or meetings that overrun—and use the information to notify the next meeting about your delay, or even rebook a flight for you.⁶⁸

Crime prevention based on algorithms is quickly becoming a very popular topic among law enforcement officials. These programs

are essentially using big data such as crime statistics, social media, mobile phone locations, and traffic data to predict where a crime may happen so that police patrols in that area can be stepped up. In some cases, eerily reminding us of the “precogs” from *Minority Report*,⁶⁹ individuals have even been singled out for a visit by a social worker or a police official because the system indicated that they were very likely to commit a crime.

Imagine where this could go once the Internet of Things (IoT) rolls out globally, with sensor networks connecting hundreds of billions of objects such as traffic lights, cars, and environmental monitors. Imagine the anticipatory, predictive potential once we have AI tools to make sense out of all that data. In drug discovery, an AI tool running on a quantum computer could map out trillions of molecular combinations and instantly identify those that may work for a given treatment, or even help prevent the onset of a disease to begin with.

Imagine what could happen once notes and coins have gone digital, and every tiny purchase is trackable instantly—vastly more efficient yet also vastly more invasive. Lucrative digital transformations or Brave New World?

Despite the tantalizing promises that anticipatory technologies seem to offer, I see a number of vexing ethical issues emerging very quickly—key among them being:

- **Dependency** – Leaving our thinking to software and algorithms because it’s just so much more convenient and fast.
- **Confusion** – Not knowing if it was the intended human who replied to my emails, or her AI assistant. Or even not knowing if I made my own decision or if I was manipulated by my IDA.
- **Loss of control** – Not having a way of knowing if the AI’s anticipation was correct or not, as we could not possibly track the system’s logic or even comprehend the workings of a quantum computing-fueled, machine-learning system. In other words, we would need to either trust it completely or not at all, similar to the dilemma that some airplane pilots are already facing with their autopilot systems.

- **Abdication** – Being tempted to leave more tasks to systems that would handle them for us, whether it is coordinating personal schedules, making appointments, or answering simple emails. Then, of course, it would be very likely that we would simply blame the cloud/bot/AI if something went wrong.

Megashift 10: Robotization

Robots are the embodiment of all these Megashifts, where everything is converging in some spectacular new creations—and they are going to be absolutely everywhere, like it or not. As science makes big leaps in natural language understanding, image recognition, battery power, and new materials that allow better movement skills, we can expect the price of robots to fall dramatically while their usefulness—as well as their likeability—will skyrocket. Some robots might even be 3D printed, just as the first cars are now being manufactured almost entirely with 3D printers.⁷⁰

The bottom line is that, as we head into exponential change, we must also collaborate to address ethics, culture, and values. Otherwise, it is certain that technology will gradually then suddenly become the purpose of our lives, rather than the tool to discover the purpose.

About The Author

Listed by *Wired Magazine* as one of the top 100 most influential people in Europe (2015), Gerd Leonhard's work focusses on the future of humanity and technology, digital transformation, big data, automation, AI and robotics, media, content, marketing and advertising, telecommunications, culture and tourism, banking and financial services, government and leadership. In his keynotes, presentations, workshops and advisory sessions Gerd often addresses topics such as digital darwinism and the challenges of digital transformation, the redefinition of human-machine relationships, the future of work and jobs, privacy in the era of big data, the sharing economy, and many more. His presentations are renowned for a hard-hitting and provocative yet inspiring, humorous and motivating style.

Gerd is a much sought-after speaker, having presented at more than 1500 events in 50+ countries since 2005. His list of clients include Google, Sony, UBS, Mastercard, Unilever, Lloyds Bank, WWF, Nokia, *The Guardian*, Telkom Indonesia, Siemens, RTL, ITV, BBC, France Telecom, Orange, Deutsche Telekom, MTN, *The Financial Times*, DDB, Ogilvy, Omnicom, The EU Commission, Mandarin Oriental Hotel Group, VISA, and many others. He resides in Zürich, Switzerland.

Further information on Gerd Leonhard and his work:

Gerd's show reel:	https://youtu.be/oq0ci3a243k
The Futures Agency:	www.thefuturesagency.com
English Website:	www.futuristgerd.com
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Contact:	gerd@thefuturesagency.com

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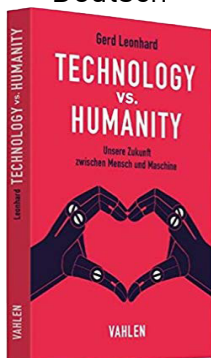
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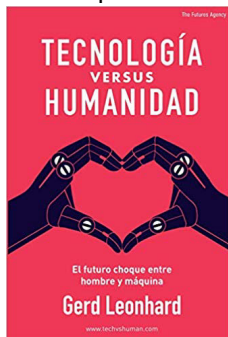
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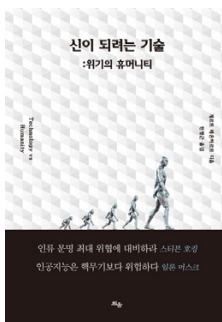
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