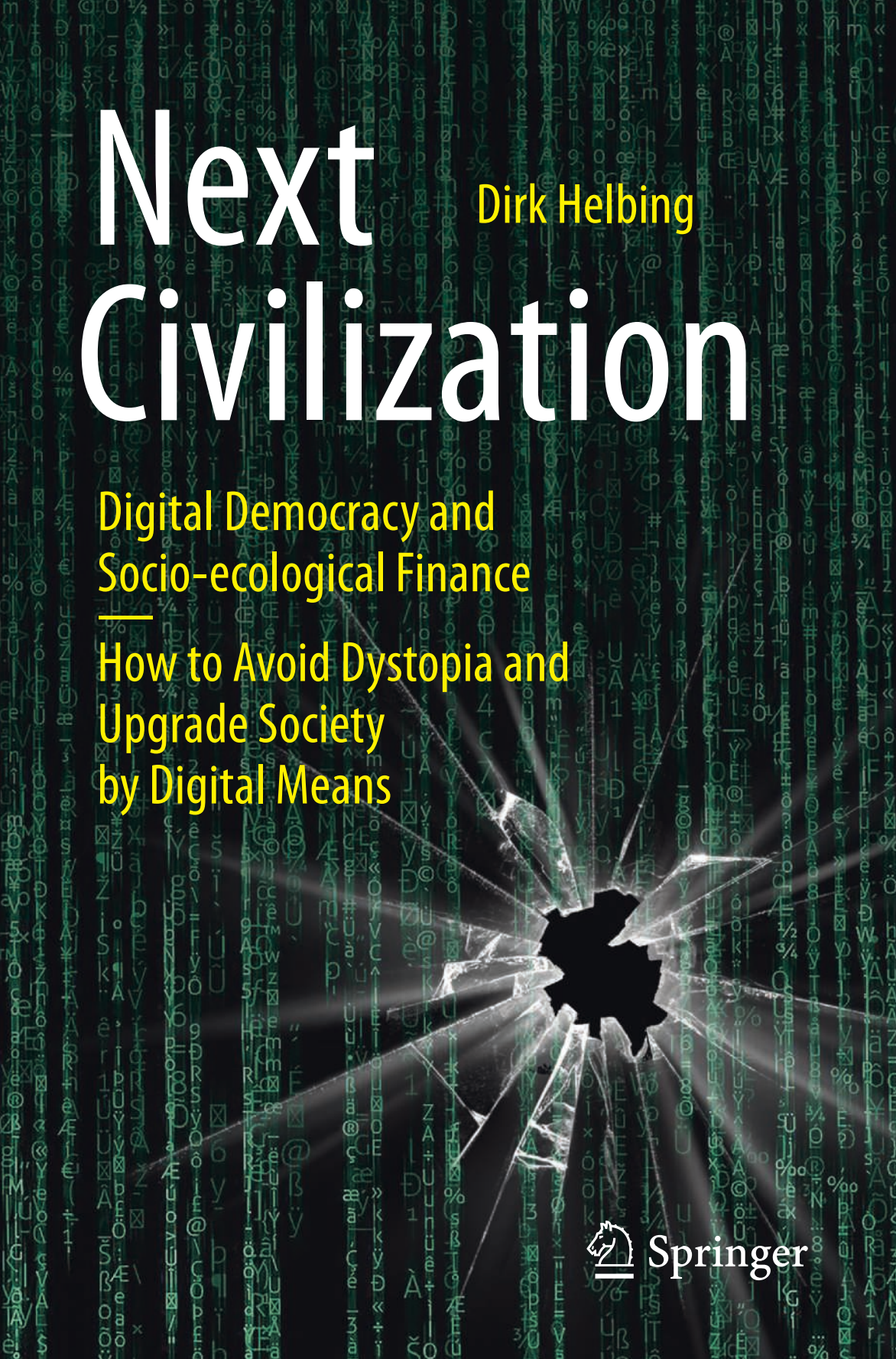
Next Civilization

Dirk Helbing

Digital Democracy and Socio-ecological Finance

How to Avoid Dystopia and Upgrade Society by Digital Means



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Digital Democracy and Socio-Ecological Finance—How to Avoid Dystopia and Upgrade Society by Digital Means

Second Edition

Springer

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ISBN 978-3-030-62329-6 ISBN 978-3-030-62330-2 (eBook)
https://doi.org/10.1007/978-3-030-62330-2

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

I would like to dedicate this book to
Dietmar Huber
for the incredible support he has given to me
over so many years.

Acknowledgements

I would like to thank the FuturICT community for the many inspiring discussions and also everyone, who had to be patient with me in the last couple of years, including my parents.

I am also very grateful to Philip Ball, Stefano Bennati, Anna Carbone, Andreas Diekmann, Jeroen van den Hoven, Dietmar Huber, Eoin Jones, Caleb Koch, Richard Mann, Heinrich Nax, Paul Ormerod, Evangelos Pournaras, Kay-Ti Tan, and others for their valuable feedback on the manuscript and the many improvements (but don't hold them responsible for any contents of this book). Jan Fasnacht, Petr Neugebauer, Petra Parikova, and Felix Schulz have been a great help with figures, formatting, references, permissions, and cover designs.

Furthermore, I would like to thank the Wissenschaftskolleg zu Berlin—Institute for Advanced Study for the creative atmosphere and excellent opportunity to do research and prepare this book.[1]

[1]I also like to acknowledge support from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No. 833168), see: Using the Wisdom of Crowds to Make Cities Smarter, FuturICT Blog (March 28, 2019) http://futurict.blogspot.com/2019/03/using-wisdom-of-crowds-to-make-cities.html; furthermore, see: ERC 2018 Advanced Grants Highlighted Projects, ERC (March 27, 2019) https://erc.europa.eu/news/erc-2018-advanced-grants-highlighted-projects.

Prologue

We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness.

The United States Declaration of Independence after Thomas Jefferson[2]

Those who surrender freedom for security will not have, nor do they deserve, either one.

Benjamin Franklin[3]

Many people know me as the scientist who has worked, among other things, on traffic and pedestrian flows and crowd disasters. As some may still remember, I have also been the initiator and scientific coordinator of the FuturICT project.[4] This project attracted serious interest of *Google*, *NASA*, the US government,[5] Russia[6] and China,[7] for example.

FuturICT was a visionary project for the digital age that was in the pole position for Europe's one billion dollar flagship funding.[8] You will find more information about it in the Epilogue. In short: hundreds of scientists were ready to bring a new

[2]https://en.wikipedia.org/wiki/United_States_Declaration_of_Independence.

[3]http://www.goodreads.com/quotes/140634-those-who-surrender-freedom-for-security-will-not-have-nor.

[4]See https://web.archive.org/web/*/www.futurict.eu.

[5]The U.S. needs a FuturICT program to confront the challenges of the 21st century government, GovLoop (January 2, 2013) https://www.govloop.com/community/blog/the-u-s-needs-a-futurict-program-to-confront-the-challenges-of-21st-century-government/.

[6]The FuturICT project on Russian TV: https://youtu.be/H3aKfswfGag.

[7]The FuturICT project on Chinese National TV: https://youtu.be/a4rxb2r9SdI.

[8]See http://www.futurict.eu and Participatory Science and Computing for Our Complex World, EPJ Special Topics 214 (2012) https://link.springer.com/journal/11734/214/1/page/1.

paradigm for the world on the way. But, then, to everyone's—including our competitors'—surprise, another flagship candidate was chosen.[9] With the 1 billion Euro Human Brain Project,[10] Europe wanted to build a realistic brain in silico, and Barack Obama announced a multi-billion dollar Brain Initiative.[11] With this, the transhumanist era was launched.[12] In the course of this book, we will understand the worrying implications of this.

In principle, it is a normal thing that one project wins and another one loses, and people move on. However, here, things were pretty different for various reasons. Whatever part of the project I wanted to follow up on—Nervousnet,[13] for example—was seriously obstructed. This applied also to our work on "Digital Democracy",[14] which was repeatedly not even accessible on the Internet. Furthermore, I was permanently put under pressure for years, and so I wondered what was going on…

My discoveries were highly concerning.[15] In the meantime, a digital mirror world[16] *has* become reality[17]—but without privacy, ethics, participation and democracy, it seems. Instead of a visionary, almost utopian project, it appears that dystopia is on its way, as I will show in the course of this book (besides the great potentials of the digital revolution, too).

[9]Neelie Kroes & Prof. Henry Markram: Human Brain Project (January 29, 2013) https://www.youtube.com/watch?v=DsZ_LBdthC0.

[10]See https://en.wikipedia.org/wiki/Human_Brain_Project and https://www.humanbrainproject.eu.

[11]Obama launches multi-billion dollar brain-map project, Nature NewsBlog (April 2, 2013) http://blogs.nature.com/news/2013/04/obama-launches-ambitious-brain-map-project-with-100-million.html.

[12]The Age of Transhuman Politics Has Begun, Telepolis (April 12, 2015) https://www.heise.de/tp/features/The-Age-of-Transhumanist-Politics-Has-Begun-3371228.html?seite=all.

[13]See https://web.archive.org/web/*/nervousnet.info; Creating a Planetary Nervous System Together, TEDx Groningen (February 5, 2015) https://www.youtube.com/watch?v=BKcWPdSUJVA; A digital Nervousnet for everyone and the golden age of complexity science (talk given at the ICCSS2015) https://www.youtube.com/watch?v=pN2hAcr6ujk.

[14]D. Helbing and E. Pournaras, Build Digital Democracy, Nature 527, 33-34 (2015) https://www.nature.com/news/society-build-digital-democracy-1.18690.

[15]Some of them have found their way into the Science Fiction „iGod" by Willemijn Dicke and myself, published at CreateSpace (2017).

[16]Virtual 'mirror' of world to help predict future, The Sunday Times (January 6, 2013) https://www.thetimes.co.uk/article/virtual-mirror-of-world-to-help-predict-future-rcflmwx0dss.

[17]Sentient world: war games on the grandest scale, The Register (June 23, 2007) https://www.theregister.com/2007/06/23/sentient_worlds/; The era of digital twins and the mirror world, Medium (May 5, 2020) https://medium.com/@nomoko/the-era-of-digital-twins-and-the-mirror-world-82b33e3e3d46.

I have been warning the world about the dangers of dual use[18] of digital technologies since 2011.[19] After the FuturICT flagship was turned down, I got concerned and started to alert the public.[20] In the years since 2013, hundreds of newspaper articles appeared (these can be found with *Google* News). I have given several hundred talks, which were uploaded to the FuturICT youtube channel[21] (but not all of them are publicly accessible). I have also published dozens of blogs (see http://futurict.blogspot.com), many of which appeared in two books entitled "Thinking Ahead"[22] and "Towards Digital Enlightenment".[23]

Furthermore, I have worked on the self-published book "The Automation of Society Is Next: How to Survive the Digital Revolution",[24] which is written for a scientifically interested readership that is open to philosophical, ethical and programmatic considerations. The 10 chapters from 2015 (Chaps. 1–5 and 7–11) have become the core of this book with the title *Next Civilization*, but I have added 4 new chapters that were written in 2019 (Chap. 14) and 2020 (Chaps. 6, 12 and 13). For the sake of historical authenticity, I left the previous chapters largely unchanged.

From today's perspective, it is hard to imagine that the 2015 version of the book was highly controversial. At that time, a global digital control system was in the making. My alternative vision of the future, based on distributed organization, coordination, self-organization, and self-governance, fundamentally questioned the data-driven paradigm controlled by a powerful Artificial Intelligence (AI).

At that time, many were looking forward to the "singularity", after which we would see a superintelligent system or "digital God,"[25] which may be allowed to reign the world like a "benevolent dictator",[26] based on mass surveillance data. It could also be tasked to make the world sustainable. Unfortunately, the Artificial Intelligence system may figure out that a "depopulation strategy" might "fix the

[18]See https://en.wikipedia.org/wiki/Dual-use_technology.

[19]See the second part of D. Helbing and S. Balietti, From social data mining to forecasting socio-economic crises, EPJ Special Topics 195, 3–68 (2011) https://link.springer.com/article/10.1140/epjst/e2011-01401-8.

[20]Probably the first contribution of this kind was "Google als Gott?", published in the NZZ on March 20, 2013, https://www.nzz.ch/startseite/google-als-gott-1.18049950; English translation: Google as God?, in D. Helbing (ed.) Thinking Ahead (Springer, 2015) Chap. 8, https://www.springerprofessional.de/en/google-as-god-opportunities-and-risks-of-the-information-age/2369816, https://arxiv.org/pdf/1304.3271.

[21]See https://www.youtube.com/futurict.

[22]D. Helbing (ed.) Thinking Ahead: Essays on Big Data, Digital Revolution, and Participatory Market Society (Springer, 2015).

[23]D. Helbing (ed.) Towards Digital Enlightenment: Essays on the Dark and Light Sides of the Digital Revolution (Springer, 2019).

[24]D. Helbing, The Automation of Society Is Next: How to Survive the Digital Revolution (CreateSpace, 2015).

[25]Google and the Birth of a Digital God?, The Globalist (December 25, 2017) https://www.theglobalist.com/google-artificial-intelligence-big-data-technology-future/.

[26]See https://en.wikipedia.org/wiki/Benevolent_dictatorship.

problem". Later on, you will learn that this terrible scenario is not just theoretical, but a real possibility and serious threat.

I have, therefore, started to work on concepts that could make the world more sustainable in a democratic way: "digital democracy," "City Olympics," "democratic capitalism," and a "socio-ecological finance system" ("FIN4") to boost a circular economy[27]—to mention just a few of the ideas featured in Chaps. 7–13. In other words, there are surely alternatives to a dystopian future, but we would have to bring them on the way.

It turns out, however, that this is more difficult than expected, because many stakeholders seem to have different plans in mind, such as China, for example, or the big tech companies of "surveillance capitalism". These often appear to be more interested in maximizing power or profit than in "saving the world". And even those who claim that they want to save the world (such as CERN,[28] the United Nations,[29] and the World Economic Forum[30]) seem to pursue a centralized approach based on mass surveillance, with little transparency and no democratic participation.

In the end, one of the people who probably know more about this made a worrying statement in front of the United Nations' General Assembly 2019:

> *"Can we still have confidence in politics, in business, in international organizations? These are questions to which we must find answers at our General Assembly".*[31]

In fact, the past years have been a tough time characterized by a global struggle for the path into the future. The following events give just a glimpse of what has happened in these years.[32]

[27]See https://en.wikipedia.org/wiki/Circular_economy.

[28]CERN: The gulf between machine learning and AI, The Inquirer (July 29, 2015) https://web.archive.org/web/20150731231358/https://www.theinquirer.net/inquirer/feature/2419669/cern-the-gulf-between-machine-learning-and-artificial-intelligence.

[29]UN and CERN celebrate science for peace and development and CERN's 60th anniversary (October 20, 2014) https://home.cern/news/press-release/cern/un-and-cern-celebrate-science-peace-and-development-and-cerns-60th.

[30]Shaping the Future of Cybersecurity and Digital Trust, https://www.weforum.org/platforms/shaping-the-future-of-cybersecurity-and-digital-trust; accordingly, the Global Centre for Cybersecurity (https://www.weforum.org/videos/global-centre-for-cybersecurity) brings together actors from America, Russia, China, Israel, Saudi Arabia and many other countries, Europol, Interpol, and companies from the banking, insurance, oil and Internet sectors, in particular Cisco and Huawei, Amazon, IBM, Mastercard, Microsoft, Palantir and PayPal.

[31]Official Speech of Federal President Ueli Maurer in front of the UN General Assembly, New York (September 24, 2019) https://www.newsd.admin.ch/newsd/message/attachments/58526.pdf.

[32]A more detailed timeline seems to be given by this Connectivist blog: https://theconnectivist.wordpress.com/2019/08/06/log-of-the-rightwing-power-grab-of-society/, https://web.archive.org/web/*/https://theconnectivist.wordpress.com/2019/08/06/log-of-the-rightwing-power-grab-of-society/.

On September 25, 2015, for example, a Snowden revelation was published about the "Karma Police" program run by British secret service GCHQ, which judges (the value of) everyone's life based on mass surveillance.[33] On the same day, Pope Francis promoted the Sustainability Development Goals (Agenda 2030) at the United Nation's general assembly.[34] I mention this here, because—believe it or not—I sent him a preprint of "The Automation of Society Is Next: How to Survive the Digital Revolution" before (it was my only mail to a pope ever). Just ahead of his speech, on September 24, 2015, and on September 11, 2015, Saudi Arabia suffered from a twin disaster. It was the biggest tragedy in the history of the Muslim pilgrimage[35] and felt like part of the apocalypse.

As a follow-up to the UN general assembly, from November 30 to December 16, 2015, the Paris Agreement was worked out, which tried to bring a binding global contract to fight climate change on the way.[36] However, before the US Congress signed the agreement, Donald Trump was elected US president, who later quit the international climate deal.[37]

Shortly before the Paris Agreement, I published the Digital Manifesto ("Digital Democracy Rather than Data Dictatorship")[38] together with an interdisciplinary team of scientists. The German online version appeared on November 12, 2015, but one day later, the world got distracted by the shocking terror attacks in Paris[39] ahead of the climate summit. The publication of the English translation was ready to be published in Scientific American the week after. However, it got delayed for more than a year (in fact, until the end of the Obama administration).

[33]British 'Karma Police' program carries out mass surveillance of the web, The Verge (September 25, 2015) https://www.theverge.com/2015/9/25/9397119/gchq-karma-police-web-surveillance; Profiled: From Radio to Porn, British Spies Track Web Users' Online Identities, The Intercept (September 25, 2015) https://theintercept.com/2015/09/25/gchq-radio-porn-spies-track-web-users-online-identities/.

[34]Pope Francis Addresses U.N., Calling for Peace and Environmental Justice, The Guardian (September 25, 2015) https://www.nytimes.com/2015/09/26/world/europe/pope-francis-united-nations.html; United Nations Sustainable Development Summit 2015, https://www.unaids.org/en/resources/presscentre/featurestories/2015/september/20150925_UN_Summit_opening.

[35]See https://en.wikipedia.org/wiki/2015_Mina_stampede and K. Haase, M. Kasper, M. Koch, and S. Müller, A Pilgrim Scheduling Approach to Increase Safety During the Hajj, Operations Research 67(2), 376–406 (2019) https://pubsonline.informs.org/doi/abs/10.1287/opre.2018.1798; I.Ö. Verbas et al. Integrated Optimization and Simulation Framework for Large-Scale Crowd Management Application, Transportation Research Record 2560, 57–66 (2016) https://journals.sagepub.com/doi/pdf/10.3141/2560-07.

[36]See https://en.wikipedia.org/wiki/Paris_Agreement.

[37]See https://en.wikipedia.org/wiki/United_States_withdrawal_from_the_Paris_Agreement.

[38]Das Digital-Manifest: Digitale Demokratie statt Datendiktatur, Spektrum der Wissenschaft (November 12, 2015) https://www.spektrum.de/thema/das-digital-manifest/1375924; Eine Strategie für das digitale Zeitalter, https://www.spektrum.de/kolumne/eine-strategie-fuer-das-digitale-zeitalter/1376083.

[39]See https://en.wikipedia.org/wiki/November_2015_Paris_attacks.

Already before Obama left his office, it seems that China was trying to take over the role of the world's leading superpower. At the G20 summit in Hangzhou in September 2016, Obama was denied the usual red carpet treatment.[40] Before this happened, on April 30, 2016, Obama had warned the world[41]:

> *"... this is also a time around the world when some of the fundamental ideals of liberal democracies are under attack, and when notions of objectivity, and of a free press, and of facts, and of evidence are trying to be undermined. Or, in some cases, ignored entirely.*
>
> *And in such a climate, it's not enough just to give people a megaphone. And that's why your power and your responsibility to dig and to question and to counter distortions and untruths is more important than ever".*

This hinted at the upcoming post truth era,[42] which apparently took over after the control of the Internet was given to ICANN at the end of September 2016.[43] It seems this cleared the way for a highly personalized Internet (using surveillance data about all of us). The development was complemented by two laws allowing for (counter-)propaganda.[44] I believe, we have been in a kind of information war[45] ever since. After the Cambridge Analytica scandal,[46] we know how much this development has challenged democracies all over the world.

[40]Barack Obama 'deliberately snubbed' by Chinese in chaotic arrival at G20, The Guardian (September 4, 2016) https://www.theguardian.com/world/2016/sep/04/barack-obama-deliberately-snubbed-by-chinese-in-chaotic-arrival-at-g20.

[41]"Obama out": President Barack Obama's hilarious final White House Correspondents' Dinner speech (April 30, 2016) https://www.youtube.com/watch?v=NxFkEj7KPC0; see also https://obamawhitehouse.archives.gov/the-press-office/2016/05/01/remarks-president-white-house-correspondents-dinner.

[42]See https://en.wikipedia.org/wiki/Post-truth_politics.

[43]An Internet Giveaway to the U.N., Wall Street Journal (August 28 2016) https://www.wsj.com/articles/an-internet-giveaway-to-the-u-n-1472421165.

[44]See https://en.wikipedia.org/wiki/Smith–Mundt_Act, https://en.wikipedia.org/wiki/Countering_Foreign_Propaganda_and_Disinformation_Act.

[45]See https://en.wikipedia.org/wiki/Information_warfare; 'I made Steve Bannon's psychological warfare tool': Meet the data war whistleblower, The Guardian (March 18, 2018) https://www.theguardian.com/news/2018/mar/17/data-war-whistleblower-christopher-wylie-faceook-nix-bannon-trump; Before Trump, Cambridge Analytica quietly built "psyops" for militaries, FastCompany (September 25, 2019) https://www.fastcompany.com/90235437/before-trump-cambridge-analytica-parent-built-weapons-for-war.

[46]The Cambridge Analytica Files, The Guardian, https://www.theguardian.com/news/series/cambridge-analytica-files.

You are certainly aware that the struggle for the future of this planet has further intensified since the world started suffering from COVID-19.[47] So, if you want to understand what might come next and what are the alternatives, it is about time to read this book, because these developments will likely affect your life much more than you ever have imagined.

Zürich, Switzerland
August, 2020[48]

[47]See https://en.wikipedia.org/wiki/COVID-19_pandemic, https://en.wikipedia.org/wiki/List_of_COVID-19_pandemic_legislation.

[48]Where no date for the access of an Internet URL is given: all links were checked and accessed around August 8, 2020, if not specified otherwise. If an URL is not anymore accessible, please try to find it via the Internet Archive/Wayback Machine at https://archive.org/web/. Many scientific references may, for example, be found via https://scholar.google.com or https://www.researchgate.net

Contents

Chapter 1
Introduction: The Digital Society

A Better Future or Worse?

Smartphones, tablets and app stores with almost unlimited possibilities have become symbols of the digital revolution. However, while these innovations make our lives more comfortable and interesting, they herald a much more fundamental transformation. Advances in digital technology now affect the way we learn, decide, and interact. By harnessing „Big Data", the „Internet of Things", and Artificial Intelligence (AI), we can create smart homes and smart cities. But this is only the tip of the iceberg – our entire economy and society will also dramatically change. What are the opportunities and risks related to this? Are we heading towards digital slavery or freedom? What forces are at work and how can we use them to create a smarter society? This book offers a guided tour through the new, digital age ahead.

After the automation of factories and the creation of self-driving cars, the automation of society is next. While we were busy with our smartphones, the world has secretly changed behind our backs. In fact, our world is changing with increasing speed, and much of that change is being driven by developments in Information and Communications Technology (ICT). These technologies, such as laptop computers, mobile phones, tablets and smart watches, seemed to be about convenience. They came along and enabled us to calculate, communicate and archive with greater speed and efficiency than ever before. However, there was very little recognition that, one day, they would not only facilitate our cultural discourse and institutions, but also reshape our entire world. Large-scale mass surveillance, the global spread of *Uber* taxis and the *BitCoin* crypto-currency are just a few of the irritating symptoms of the digital era to come.

1.1 Living in the Age of "Big Data"

Suddenly, there is also a great hype about "Big Data". No wonder Dan Ariely compared the frenzy about Big Data with teenage sex:

D. Helbing, *Next Civilization*,
https://doi.org/10.1007/978-3-030-62330-2_1

"everyone talks about it, nobody really knows how to do it, everyone thinks everyone else is doing it, so everyone claims they are doing it…"

But some are actually doing it. In fact, "Big Data" has already given rise to many interesting applications, such as real-time language translation. So, what is "Big Data"? The term refers to massive amounts of data, which have been collected about technological, social, economic and environmental systems and activities. To get an idea of "Big Data," imagine the digital traces that almost all our activities leave, including the data created by our consumption and movement patterns. Every single minute, we produce about 700,000 *Google* queries and 500,000 *Facebook* comments. If you add all of the location data of people using smartphones, the consumption data of people who buy things, and cookies which track every click and tap of our online activity, you will begin to comprehend the enormity of "Big Data".

All the contents collected in the history of humankind until the year 2003 are estimated to amount to five billion gigabytes—the data volume that around 2015 was produced approximately every day. While we have been speaking of an "information age" since the middle of last century, the digital era started only in 2002. Since then, the digital storage capacity has exceeded the analog one. Today, more than 95% of all data are available in digital form. Even by avoiding credit card transactions, social media and digital technologies, it is no longer possible to completely avoid digital footprints on the Internet.

1.2 Data Sets Bigger Than the Largest Library

The availability of Big Data about almost every aspect of our lives, institutions and cultures has fueled the hope that we could now solve the world's problems. Every Internet purchase we make generates data about our preferences, finances and location that will be stored on a server somewhere and used for various purposes, possibly without our consent. Cell phones disclose where we are, and private messages and conversations are being analyzed. It will probably not be long before every newborn baby is genome-sequenced at birth. Books are being digitized and collated in immense, searchable databases of words that are being data-mined to enable "culturomics", a field which puts history, society, art and cultural trends under the lens. Aggregated data can be used to reveal unexpected facts in a way that would never have been possible before the digital age. For example, an analysis of *Google* searches can reveal an impending flu epidemic.

This avalanche of data continues to grow. The introduction of technologies such as *Google Glass* encourages people to document and archive almost every aspect of their lives. Further data sets include credit-card transactions, communication data, *Google Earth* imagery, public news, comments and blogs. These data sources have

been termed "Big Data" and are creating an increasingly accurate digital picture of our physical and social world, as well as the global economy.

"Big Data" will certainly change our world. The term was coined more than 15 years ago to describe data sets so big that they can no longer be analyzed using standard computational methods. If we are to benefit from Big Data, we must learn to "drill" and "refine" it into useful information and knowledge. This is a significant challenge.

The tremendous increase in the volume of data is attributable to four important technological innovations. First, the *Internet* enables global communication between electronic devices. Second, the *World Wide Web* (WWW) has created a network of globally accessible websites, which emerged as a result of the invention of the Hypertext Transfer Protocol (HTTP). Third, the emergence of *social media* platforms such as *Facebook*, *Google+*, *WhatsApp* and *Twitter* has created social communication networks. Finally, a wide range of previously offline devices such as TV sets, fridges, coffee machines, cameras as well as sensors, smart wearable devices (such as activity trackers) and machines are now connected to the Internet, creating the "Internet of Things" (IoT) or "Internet of Everything" (IoE). Meanwhile, the data sets collected by companies such as *eBay*, *Walmart* or *Facebook*, must be measured in petabytes—1 million billion bytes. This amounts to more than 100 times the information stored in the US Library of Congress, which is the largest physical library in the world.

Mining Big Data offers the potential to create new ways to optimize processes, identify interdependencies and make informed decisions. However, Big Data also produces at least four major new challenges (the "four V's"). First, the unprecedented *volume* of data means that we need immense processing power and storage capacity to deal with the huge amounts of data. Second, the *velocity* at which data must be processed has increased: now, continuous data streams must often be analyzed in real-time. Third, Big Data is mostly unstructured, and the resulting *variety* of data is difficult to organize and analyze. Finally, the *veracity* of the data may be difficult to handle because Big Data tends to contain errors and is usually neither representative nor complete.

1.3 Will a Digital Revolution Solve Our Problems?

Let us see what an evidence-based approach building on the wealth of today's data can do for us. In the past, whenever a problem had to be solved, the best course of action was to "ask the experts". These experts would go to the library, collect up-to-date knowledge, and supervise Ph.D. students who would help to fill gaps in existing knowledge. But this was a slow process. Nowadays, whenever people have a question, they ask *Google* or consult *Wikipedia*, for example. This might not always give the definitive or best answer, but it delivers quick answers. On average, decisions taken in this way may even be better than many decisions made in the past. It is no wonder, therefore, that policymakers love the Big Data approach, which seems

to provide immediate answers. Business people sensing the immense commercial opportunities are getting excited too.

1.4 Big Data Gold Rush for the Twenty-First Century's Oil

The fact that we have much more information about our world than ever before is both a blessing and a curse. The accumulation of socio-economic data often implies a long-term intrusion into personal privacy and raises a number of important issues. It cannot be denied that Big Data is a powerful resource that supports evidence-based decision-making and that it holds unprecedented potential for business, politics, science and citizens. Recently, the social media portal *WhatsApp* was sold to *Facebook* for $19 billion, when it had 450 million users. This sale price implies that each employee generated almost half a billion dollars in share value.

There is no doubt that Big Data creates tremendous opportunities, not just because of its application in process optimization and marketing, but also because the information itself is becoming monetized. As demonstrated by the virtual currency *BitCoin*, it is now even possible to turn bits into monetary value. It can be literally said that data can be mined into money in a way that would previously have been considered a fairy tale. For a time, *BitCoins* were even more valuable than gold.

Therefore, it is no surprise that many experts and technology gurus claim that Big Data is the "oil of the twenty-first century", a new way of making money—big money. Although many Big Data sets are proprietary, the consultancy company *McKinsey* recently estimated that the potential value of Open Data alone is $3–5 trillions per year.[1] If the worth of this publicly available information were to be evenly distributed among the world's population, every person on Earth would receive an additional $700 per year. Therefore, the potential of Open Data significantly exceeds the value of the international free trade and service agreements that are currently under secret negotiation.[2] Given these numbers, are we currently setting the right political and economic priorities? This is a question we must pay attention to, because it will determine our future.

The potential of Big Data spans every area of social activity, from processing human language and managing financial assets, to empowering cities to balance energy consumption and production. Big Data also holds the promise of enabling us to better protect the environment, to detect and reduce risks, and to discover opportunities that would otherwise have been missed. In the area of personalized medicine, Big Data will probably make it possible to tailor medications to patients in order to increase their effectiveness and reduce their side effects. Big Data will

[1] https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/open-data-unlocking-innovation-and-performance-with-liquid-information.

[2] I recommend the readers to look up Wikipedia to inform themselves about the impending international agreements coming under the abbreviations TTIP, CETA, TPP, and TISA. It seems that these would dramatically increase the power of multi-national corporations. Would this be good or bad?

also accelerate the research and development of new drugs and focus resources on the areas of greatest need.

It is clear, therefore, that the potential applications of Big Data are various and rapidly spreading. While it will enable personalized services and products, optimized production and distribution processes, as well as "smart cities", it will reveal also unexpected links between our activities. But beyond this, where are we heading?

1.5 Will Artificial Intelligence Overtake Us?

Today, an average mobile phone is more powerful than the computers used to send the Apollo rocket to the moon and even the *Cray-2* supercomputer thirty years ago, which weighted several tons and had the size of a building. This amazing progress is a result of "Moore's law", which posits that computer processing power increases exponentially. But thanks to powerful "machine learning" methods, information systems are becoming more intelligent, too. They do calculations faster than us, they play chess better than us, they remember information longer than us, and they perform more and more tasks that only humans could do in the past. Will they soon be smarter than us? Are the days counted when humans were the "crown of creation"? The famous futurist Ray Kurzweil (*1948), now a director of engineering at *Google*, was the first to claim that this critical moment (the so-called "singularity") is near.[3]

A few years ago, when I read that Artificial Intelligence (AI) might pose a serious threat to humanity, I found this hard to imagine, even ridiculous. However, experts now predict that computers will be able to perform most tasks better than humans in 5–10 years, and reach brain-like functionality within 10–25 years. The AI systems of today are no longer expert systems programmed by computer scientists—they are learning and evolving. To understand the implications, I recommend you to watch some eye-opening videos on deep learning and artificial intelligence.[4] These videos demonstrate that most of the activities we earn our money with today (such as reading and listening to language, distinguishing different patterns, and performing routines) can now be done by computers almost as well as by humans, if not better. Jim Spohrer's perspective on *IBM*'s cognitive computing products is as follows:[5] The first Artificial Intelligence applications will be our tools. As they get smarter, they will become our "partners", and when they overtake us, they will be our "coaches".

Will algorithms, computers, or robots be our bosses in a few decades from now? The Massachusetts Institute of Technology has started to study such scenarios.[6] It is extremely important therefore to realize that the digital revolution is not just

[3] Kurzweil [1, 2].

[4] For example, you may watch this TEDx video of Jeremy Howard to get an idea of what machine learning is currently capable of: https://www.youtube.com/watch?v=xx310zM3tLs.

[5] See https://www.youtube.com/watch?v=E7PVBGtEYyg.

[6] MIT Study Shows People Would Rather Take Orders From A Robot Than Their Boss, http://www.businessinsider.com/robots-as-bosses-2014-8?IR=T.

about more powerful computers, better smartphones or fancier gadgets. The digital revolution will change all our personal lives, and it will transform entire economies and societies. In fact, in the coming two or three decades we will see some dramatic changes. A lot of production and services will become automated, and this will fundamentally change the way we work in the future.

Quite soon, within the next two decades or so, less than 50% of people will have jobs for which they have been trained (i.e. agriculture, industry or services).[7] Even highly skilled jobs will be at risk. How will the masses of personal data collected about each of us then be used?

1.6 When Big Data Starts to Steer Our Lives

It may sound far-fetched at first, but we must ask this question: "Will we be remotely controlled by personalized information, or is this happening already?" It is clear that *Google* and *Facebook* know very well what we are interested in when they place individually tailored ads that often match our interests and tastes. *Google Now* is an example of a smart app that tells you what to do, if you have signed up for it. For instance, if there is a traffic jam on the way to your next appointment, *Google Now* may suggest you to leave 15 min earlier in order to be on time. Similarly, *Amazon* suggests what we might want to buy, and *Trip Advisor* suggests what destinations to visit and what hotels to book. *Twitter* tells us what others think—and what we should perhaps think, too. *Facebook* suggests whom to be friend with. Apps like *OkCupid* even suggest whom we might date.

While all these services can certainly be helpful we might ask: what will be the consequences? Will we end up living in a digital "golden cage"—a "filter bubble" as Eli Pariser calls it?[8] Will we just execute what our smart devices tell us to do? Modern learning software already corrects us when we make mistakes. Smart wristbands tell us how many more steps we should make today. Eye trackers can discover if we are tired or stressed, and computers can predict when our performance will decrease. In other words, we are increasingly patronized in our decision making by computer programs. Will we soon be incompetent to live on our own? And, are we sliding into a "nanny state", where we don't have a say? Has our decision-making, has democracy been "hacked"?

Why should we care? Isn't it just great that computers do calculations for us more quickly than we can do them ourselves? Isn't it fantastic that our smartphones help us manage our agendas, and that *Google Maps* tells us the way to go? Why not ask *Apple's Siri* to recommend us a restaurant? I certainly don't object to any of these functions, but it is important to recognize that this is just the beginning of what is to come. Little by little, our role as self-determined decision-makers is being eroded. The next logical step will be the automation of society. How might this look like?

[7] Frey and Osborne [3].

[8] Pariser [4].

1.7 The Cybernetic Society

This question brings us to an old concept that goes back to Norbert Wiener (1894–1964)[9] who was known as the father of control theory ("cybernetics"). Wiener imagined that our society could be controlled like a huge clockwork, where every company's and every individual's activity would be coordinated by a giant plan of how to run a society in an optimal way.

Many decades ago, Russia and other communist countries ran command economies. However, they failed to be competitive, while the capitalist approach based on free entrepreneurship thrived. At that time information systems were much more limited in power and scope than today. This has changed. Now there is a third approach besides communism and capitalism: socio-economic systems that are managed in a data-driven way. In the early 70ies Chile was the first country to attempt a "cybernetic society".[10] It established a control center, which collected the latest production data of major companies every week. This was a truly revolutionary approach, but despite its obvious advantages, the government was unable to stay in power, and Salvador Allende (1908–1973), the president of the country, had a tragic end.[11] Nevertheless, the dream of a cybernetic society has not ceased to exist.

Today, both Singapore and China are trying to plan social and economic activities in a top-down way using lots of data, and they enjoy larger growth rates than Western democracies. Therefore, many economic and political leaders raise the question: "Is democracy outdated?" Should we run our societies in a cybernetic way according to a grand plan? Will Big Data allow us to optimize our future?

1.8 Wise Kings and Benevolent Dictators, Fueled by Big Data

Given all the data one can now accumulate, is it conceivable that governments or big companies might try to build "God-like", almost "omniscient" information systems? Could these systems then make decisions like a "benevolent dictator" or "wise king"? Will they be able to avoid coordination failures and irrationality? Would it even become possible to create the best of all worlds by collecting all data globally and building a digital "crystal ball" to predict the future, as some people have suggested? If this were possible, and given that "knowledge is power", could a sort of digital "magic wand" be created by a government or company to ensure that the benevolent dictator's master plan remains on course?

What would it take to build such powerful tools? It would require information systems that knew us so well that they could manipulate our decisions by stimulating

[9] Wiener [5, 6].

[10] Medina [7].

[11] He committed suicide.

us with the right kind of personalized information. As I will show in this book, such systems are actually on their way, or they exist already.

1.9 Do We Need to Sacrifice Our Personal Freedom?

Establishing a cybernetic society has a number of important implications. For example, we would need a lot of personal data. In order to be able to control an entire society, it seems important to understand how we think, what we feel, and what we plan to do. Large amounts of personal data are essential to allow artificially intelligent machines to learn what determines our actions and how to influence them. In fact, while mass surveillance is surprisingly ineffective in fighting terrorism[12] and child abuse,[13] it seems to be very useful to establish a cybernetic society.

But as with every technology, there are serious drawbacks. We would probably lose some of the most important rights and values that have formed the bedrock of democracies and their judicial systems since the Age of Enlightenment. Secrecy and privacy would be eroded by information technologies, and with this, we would lose our security and human values such as mercy and forgiveness. With the advent of predictive policing and other proactive enforcement measures, we could see a deviation from the "presumption of innocence" principle towards the implementation of an ominous "public interest" policy at the cost of individual rights. Do we therefore need to worry about the fact that the leading Big Data nation has more people per thousand inhabitants in prison than any other country, including Russia and China?[14]

With the help of mass surveillance, it is now possible to punish even the smallest mistakes that everyone makes in an overregulated society.[15] The displayed speeding ticket for going 1 km/h too fast with my car (see Fig. 1.1) should be a wake-up call regarding what will soon possible on a much larger scale. In addition to sanctions by public authorities, will insurance companies punish us in future for eating unhealthy food? Will banks offer us punitive interest rates on loans simply because we live in the "wrong neighborhood"? Will we get restricted offers of products or services if we don't fulfill certain expectations, or will we have to pay higher prices? While

[12] The Washington Post (January 12, 2014): NSA phone record collection does little to prevent terrorist attacks, group says, https://www.washingtonpost.com/world/national-security/nsa-phone-record-collection-does-little-to-prevent-terrorist-attacks-group-says/2014/01/12/8aa860aa-77dd-11e3-8963-b4b654bcc9b2_story.html; http://securitydata.newamerica.net/nsa/analysis; Gill [8]; see also BBC News (August 24, 2009): 1000 cameras 'solve one crime'.

[13] The biggest sexual child abuse scandals revealed in the past years have actually not been discovered by digital surveillance techniques.

[14] In fact, in recent years there were about 45 million arrests in the USA (see the National Geographic of January 22, 2013: The war on drugs is a "miserable failure", https://blog.nationalgeographic.org/2013/01/22/the-war-on-drugs-is-a-miserable-failure/). About 2% of the overall population is in prison. This is about 10 times more than in many European countries (see the list of countries by incarceration rate, http://en.wikipedia.org/wiki/List_of_countries_by_incarceration_rate#Incarceration_rates. Despite this, it didn't really make the USA a safer place than Europe.

[15] In this connection I recommend to read J. Schmieder [9].

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Zürich, 29.08.07 / UAUOBD 8

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[redacted]

Übertretungsanzeige

Wir haben festgestellt, dass die Lenkerin oder der Lenker des unten genannten Fahrzeuges folgende Verkehrsregelverletzung(en) begangen hat:

Ueberschreiten allgemeiner Höchstgeschwindigkeit innerorts um 1-5 km/h

Bussenbetrag :	CHF 40.00		Devisenkurs : 1.60	**Bussenbetrag :**	**EUR 25.00**
Kontrollschild-Nr. :	[redacted]		Fahrzeugart : PW		
FahrzeughalterIn :	Helbing Dirk				
Übertretungsort :	Zürich 6, Wehntalerstrasse 200			Datum :	So-29.07.2007
Fahrtrichtung :	stadteinwärts			Zeit :	13:03 Uhr

Gemessene Geschwindigkeit	54	km/h	Massgebende Geschwindigkeit	51	km/h
Abzug der Sicherheitsmarge	-3	km/h	Abzug der Geschwindigkeitsbegrenzung	50	km/h
Massgebende Geschwindigkeit	51	km/h	**Geschwindigkeitsüberschreitung**	**1**	**km/h**

Fig. 1.1 Illustration of how citizens could be punished for any minor transgression of law, even if it is entirely harmless to society. Note that the traffic authority figured out my foreign address to send me this ticket for going 1 km/h too fast with my car, while I was actually not even the driver (which they didn't check)….

this might sound like a dystopian science fiction fantasy, much of this is already happening. China is now even planning to rate the behavior of all its citizens on a one-dimensional scale, including what they do online.[16] Opinions that match the thinking of the communist political party will be rewarded. The resulting score will be used to determine whether or not a person gets a particular job or loan.

Can such surveillance-based technology- and data-driven approaches turn a country into a "perfect clockwork"? And given that every country is exposed to global competition, is it just a matter of time until all democracies adopt such approaches? If you think this is far-fetched, it is probably good to recall that several influential decision-makers have recently praised China and Singapore as models for the

[16]China rates its own citizens—including online behaviour, see http://www.volkskrant.nl/buitenland/china-rates-its-own-citizens-including-online-behaviour~a3979668/; China: Kontrolle über alles, see http://www.zeit.de/politik/ausland/2015-07/china-plangesellschaft-xi-jinping.