COMPLETELY REVISED AND UPDATED, INCLUDING BONUS CHAPTER!

THE DRIVER IN THE DRIVERLESS CAR

HOW *YOUR* TECHNOLOGY CHOICES CREATE THE FUTURE

VIVEK WADHWA AND ALEX SALKEVER

Finalist for the *Financial Times & McKinsey Business Book of the Year*

Praise for *The Driver in the Driverless Car*

"Vivek raises one of the most important issues of our time—the use of technology to uplift rather than displace humans. His book provides an invaluable guide for assessing the benefits and risks of future technologies."

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"Exponential technologies are about to transform every aspect of our lives. Understanding the potential and implications of these technologies is crucial to every person and every company. In this book, Vivek provides you a clear and authoritative blueprint for assessing their benefits and risks."

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—Lynn Tilton, CEO, Patriarch Partners, LLC

"The questions this book raises are too important to be ignored by our political leaders or by the general public. Vivek Wadhwa compellingly explains the awesome opportunities technological advances hold for us. He also demonstrates the urgent need to establish a new system of governance to ensure that we can reap the rewards while containing the risks awaiting us."

—Kofi Annan, seventh Secretary-General, United Nations; corecipient of the Nobel Peace Prize; and founder and Chairman, Kofi Annan Foundation

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— SECOND EDITION —

Berrett–Koehler Publishers, Inc.

The Driver in the Driverless Car

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1333 Broadway, Suite 1000
Oakland, CA 94612-1921
Tel: (510) 817-2277, Fax: (510) 817-2278
www.bkconnection.com

Ordering information for print editions
Quantity sales. Special discounts are available on quantity purchases by corporations, associations, and others. For details, contact the "Special Sales Department" at the Berrett-Koehler address above.
Individual sales. Berrett-Koehler publications are available through most bookstores. They can also be ordered directly from Berrett-Koehler: Tel: (800) 929-2929; Fax: (802) 864-7626; www.bkconnection.com
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Distributed to the U.S. trade and internationally by Penguin Random House Publisher Services.

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Second Edition
Paperback print edition ISBN 978-1-5230-8553-8
PDF e-book ISBN 978-1-5230-8554-5
IDPF e-book ISBN 978-1-5230-8555-2
Digital audio ISBN 978-1-5230-8556-9

2019-1

Produced by BookMatters; copyedited by Mike Mollett; proofread by Janet Reed Blake; indexed by Leonard Rosenbaum; cover by Rob Johnson, Toprotype, Inc.

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PREFACE TO THE SECOND EDITION

I wrote this book with my good friend Alex Salkever. He served as the co-author and performed much of the research and writing. Alex is a longtime journalist and technology executive who has been a close collaborator with me on many projects. This book is as much his as it is mine. For clarity of storytelling, however, we opted to tell the book through the voice of Vivek. Many of the stories and thoughts are first-person accounts and are more appropriately written in the first person. (Also, Alex doesn't remember *The Jetsons*.) As you read the book, please consider us to be of one voice.

—Vivek Wadhwa

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PREFACE

Not long ago, I was very pessimistic about the future. I was worried about hunger and poverty, disease, overpopulation. I believed that the world would run out of clean water and energy and that we would be fighting world wars over scarce resources.

Today, I talk about this being the greatest period in history, when we will solve the grand challenges of humanity and enter an era of enlightenment and exploration such as we saw in my favorite TV series, *Star Trek*. Yes, I grew up dreaming of tricorders, replicators, and androids and wanting to be an astronaut so that I could join Starfleet Academy. Didn't all the people from my generation, of the '60s?

At Stanford, Duke, and Singularity Universities, and now at Harvard Law and Carnegie Mellon, I have spent the past eight years researching the advances in technology that are finally making science fiction a reality. It truly is amazing what is possible, as I will explain in this book. But I have come to realize that reaching Utopia will take vigilance and effort: like the course of a game of snakes and ladders, our path is strewn with hazards.

My research has made me acutely aware of the dangers

in advanced technologies. These are moving faster than people can absorb change—and offer both unprecedented rewards and unpredictable hazards.

As a society, we can make amazing things happen; and the more we understand, the better our decision making will be—and the greater the odds that we head toward *Star Trek*. Today's technology changes are happening so quickly and are so overwhelming that all of us—including technologists—can benefit from access to new tools for considering and managing them. I wrote this book in order to provide such tools, because I believe in the power of choice and the greater judgment of involved citizens. My hope is that it will help you deal with the challenges that new technologies raise now and in the future.

INTRODUCTION

It is a warm autumn morning, and I am walking through downtown Mountain View, California, when I see it. A small vehicle that looks like a cross between a golf cart and a Jetsonesque bubble-topped spaceship glides to a stop at an intersection. Someone is sitting in the passenger seat, but no one seems to be sitting in the driver's seat. How odd, I think. And then I realize I am looking at a Google car. The technology giant is headquartered in Mountain View, and the company is road-testing its diminutive autonomous cars there.

This is my first encounter with a fully autonomous vehicle on a public road in an unstructured setting.

The Google car waits patiently as a pedestrian passes in front of it. Another car across the intersection signals a left-hand turn, but the Google car has the right of way. The automated vehicle takes the initiative and smoothly accelerates through the intersection. The passenger, I notice, appears preternaturally calm.

I am both amazed and unsettled. I have heard from friends and colleagues that my reaction is not uncommon. A driverless car can challenge many assumptions about human superiority to machines.

Though I live in Silicon Valley, the reality of a driverless car is one of the most startling manifestations of the future unknowns we all face in this age of rapid technology development. Learning to drive is a rite of passage for people in materially rich nations (and becoming so in the rest of the world): a symbol of freedom, of power, and of the agency of adulthood, a parable of how brains can overcome physical limitations to expand the boundaries of what is physically possible. The act of driving a car is one that, until very recently, seemed a problem only the human brain could solve.

Driving is a combination of continuous mental risk assessment, sensory awareness, and judgment, all adapting to extremely variable surrounding conditions. Not long ago, the task seemed too complicated for robots to handle. Now, robots can drive with greater skill than humans—at least on the highways. Soon the public conversation will be about whether humans should be allowed to take control of the wheel at all.

This paradigm shift will not be without costs or controversies. For sure, widespread adoption of autonomous vehicles will eliminate the jobs of the millions of people whose living comes of driving cars, trucks, and buses (and eventually all those who pilot planes and ships). We will begin sharing our cars, in a logical extension of Uber and Lyft. But how will we handle the inevitable software faults that result in human casualties? And how will we program the machines to make the right decisions when faced with impossible choices—such as whether an autonomous car

should drive off a cliff to spare a busload of children at the cost of killing the car's human passenger?

I was surprised, upon my first sight of a Google car on the street, at how mixed my emotions were. I've come to realize that this emotional admixture reflects the countercurrents that the bow waves of these technologies are rocking all of us with: trends toward efficiency, instantaneity, networking, accessibility, and multiple simultaneous media streams, with consequences in unemployment, cognitive and social inadequacy, isolation, distraction, and cognitive and emotional overload.

Once, technology was a discrete business dominated by business systems and some cool gadgets. Slowly but surely, though, it crept into more corners of our lives; today, that creep has become a headlong rush. Technology is taking over everything: every part of our lives, every part of society, every waking moment of every day. Increasingly pervasive data networks and connected devices are enabling rapid communication and processing of information, ushering in unprecedented shifts—in everything from biology, energy, and media to politics, food, and transportation—that are redefining our future. Naturally we're uneasy; we should be. The majority of us, and our environment, may receive only the backlash of technologies chiefly designed to benefit a few. We need to feel a sense of control over our own lives; and that necessitates actually having some.

The perfect metaphor for this uneasy feeling is the Google car. We welcome a better future, but we worry about the loss of control, of pieces of our identity, and most

importantly of freedom. What are we yielding to technology? How can we decide whether technological innovation that alters our lives is worth the sacrifice?

The noted science-fiction writer William Gibson, a favorite of hackers and techies, said in a 1999 radio interview (though apparently not for the first time): "The future is already here; it's just not very evenly distributed."[1] Nearly two decades later—though the potential now exists for most of us, including the very poor, to participate in informed decision making as to its distribution and even as to bans on use of certain technologies—Gibson's observation remains valid.

I make my living thinking about the future and discussing it with others, and am privileged to live in what to most is the future. I drive an amazing Tesla Model S electric vehicle. My house, in Menlo Park, close to Stanford University, is a Passive House, extracting virtually no electricity from the grid and expending minimal energy on heating or cooling. I have a phone book–sized medical device called HealthCube, which does the same tests that hospitals do—including twelve-lead electrocardiograms and tests for blood pressure, blood sugar, cholesterol, urine protein, glucose, and troponin (related to heart attacks). With this device, I get the results almost instantaneously on my smartphone, which also happens to be cradled with electronic sensors that I can place against my chest to generate a detailed electrocardiogram to send to my doctors, from anywhere on Earth.[2]

Many of the entrepreneurs and researchers I talk with about breakthrough technologies, such as artificial intelligence and synthetic biology, are building a better future at a breakneck pace. One team built a fully functional surgical-glove prototype to deliver tactile guidance for doctors during examinations—in three weeks. Another team's visualization software, which can tell farmers the health of their crops using images from off-the-shelf drone-flying video cameras, took four weeks to build.

The distant future, then, is no longer distant. Rather, the institutions we expect to gauge and perhaps forestall new technologies' hazards, to distribute their benefits, and to help us understand and incorporate them are drowning in a sea of change as the pace of technological change outstrips them.

The shifts and the resulting massive ripple effects will, if we choose to let them, change the way we live, how long we live, and the very nature of being human. Even if my futuristic life sounds unreal, its current state is something we may laugh at within a decade as a primitive existence—because our technologists now have the tools to enable the greatest alteration of our experience of life that we will have seen since the dawn of humankind. As in all other manifest shifts—from the use of fire to the rise of agriculture and the development of sailing vessels, internal-combustion engines, and computing—this one will arise from breathtaking advances in technology. It is far larger, though, is happening far faster, and may be far more stressful to those

living through this new epoch. Inability to understand it will make our lives and the world seem even more out of control.

In the next few chapters, I will take you into this future, discussing some of the technologies that are advancing at an exponential pace and illustrating what they make possible. You will see how excited I am about their potential—and how worried, at the same time, about the risks that they create.

Broadly speaking, we will, jointly, choose one of two possible futures. The first is a utopian *Star Trek* future in which our wants and needs are met, in which we focus our lives on the attainment of knowledge and betterment of humankind. The other is a *Mad Max* dystopia: a frightening and alienating future, in which civilization destroys itself.

These are both worlds of science fiction created by Hollywood, but either could come true. We are already capable of creating a world of tricorders, replicators, remarkable transportation technologies, general wellness, and an abundance of food, water, and energy. On the other hand, we are capable too now of ushering in a jobless economy, the end of all privacy, invasive medical-record keeping, eugenics, and an ever worsening spiral of economic inequality: conditions that could create an unstable, Orwellian, or violent future that might undermine the very technology-driven progress that we so eagerly anticipate. And we know that it is possible to inadvertently unwind civilization's progress. It is precisely what Europe did when, after the Roman Empire, humanity slid into the Dark Ages, a period during

which significant chunks of knowledge and technology that the Romans had hard won through trial and error disappeared from the face of the Earth. To unwind our own civilization's amazing progress will require merely cataclysmic instability.

It is the choices we all make that will determine the outcome. Technology will surely create upheaval and destroy industries and jobs. It will change our lives for better and for worse simultaneously. But we can reach *Star Trek* if we can share the prosperity we are creating and soften its negative impacts, ensure that the benefits outweigh the risks, and gain greater autonomy rather than becoming dependent on technology.

You will see that there is no black and white; the same technologies that can be used for good can be used for evil in a continuum limited only by the choices we make jointly. All of us have a role in deciding where the lines should be drawn.

At the end of the day, you will realize that I am an optimist at heart. I sincerely believe that we will all learn, evolve, and come together as a species and do amazing things.

With that, let the journey begin.