1 When Machines Do Everything

Artificial intelligence has left the laboratory (and the movie lot) and is in your building. It's in your home. It's in your office. It's pervading all the institutions that drive our global economy. From Alexa to Nest to Siri to Uber to Waze, we are surrounded by smart machines running on incredibly powerful and self-learning software platforms. And this is just the beginning.

To date, we've been enjoying—without even really noticing—various forms of "weak" artificial intelligence (AI). It's how Amazon recommends just the right gift. How Netflix suggests the perfect film for your Sunday evening. Or how Facebook fills your newsfeed. These forms of AI have been welcome little helpers, making our days just a bit easier and more fun. Once we start using them we stop thinking about them. In just a few short years, these machines have become almost invisible to us in our personal lives.

Now AI is transitioning from being our little daily helper to something much more powerful—and disruptive—as the new machines

are rapidly outperforming the most talented of us in many endeavors. For example:

- **Games of intellect:** AI platforms can now out-compete us at some of our most challenging games—Jeopardy!, Chess, and Go. Google's AlphaGo beat world champion Go player Lee Sedol by a score of 4–1 in March 2016.[1] This was a convincing win, but not a rout. Yet with the current rate of technological advancement, in just a few years it will be inconceivable for a human to beat the new machines in such games of the mind.
- **Driving:** The driverless car, while still relatively nascent, is already a better driver than the average person. According to a Virginia Tech study, human-driven vehicles are involved in 4.2 crashes per million miles vs. 3.2 crashes per million miles for the automated car.[2] This disparity in safety will undoubtedly grow considerably in the next few years, and driverless cars, which never text behind the wheel or drive drunk, may soon become mainstream.
- **Trading:** In 2015, six of the top eight hedge funds in the United States earned around $8 billion based largely—or exclusively—on AI algorithms.[3] The machine has already won in stock picking.
- **Health care:** In medicine, the new machine is quickly surpassing the capabilities of human radiologists. Researchers at Houston Methodist Hospital utilize AI software, which interprets results of breast X-rays 30 times faster than doctors and with 99% accuracy. By contrast, mammograms reviewed by humans result in unnecessary biopsies nearly 20% of the time.[4]
- **Law:** In the legal profession, AI-enhanced computer systems are conducting discovery and due diligence far better, faster, and cheaper than the most talented team of paralegals in a white-shoe law firm. Multiple studies predict that the vast majority of paralegal work can soon be automated. We may reach a point in the not-too-distant future when relying only on humans for discovery might be grounds for malpractice.

We could go on and on with many more examples, but the point is clear; the new machines have already surpassed human capability in many ways. Moreover, with the geometric growth in the power and sophistication of these platforms, this is only a preview of coming attractions.

Thus, this rapid expansion of AI leads us to ask some big questions:

- Will a robot take my job away?
- Will my company be "Ubered"?
- What will my industry look like in 10 years?
- Will my children be better off than I am?

In the coming pages, we will answer these questions in a structured and practical manner. Based on our cumulative 100 years of experience analyzing and charting shifts in business and technology, we are fully convinced that we're now moving into a new economic era, one that will change the nature of work and the basis of competition in every industry. In this new economy, we will witness an expansion of what is possible and move from machines that do to machines that appear to learn and think.

Like It or Not, This Is Happening

What the World Economic Forum hailed in 2016 as the Fourth Industrial Revolution is now upon us: a time of economic dislocation, when old ways of production give way to new ones, and when those who can harness the power of the new machine will harvest the bounty of economic expansion.[5] In the same manner that the First Industrial Revolution was powered by the invention of the loom, the second by the steam engine, and the third by the assembly line, the fourth will be powered by machines that seem to think—what we refer to in these pages as "systems of intelligence."

This is leading to what we call the "know-it-all" business, in which leaders and managers can and should have a continuous awareness of all that is occurring in their company's operations. Where we used to guess, now we can know. These new machines—always "on," always "learning," and constantly "thinking"—will soon challenge and enhance the intellect and experience of even the savviest professionals in every sector. There's no way to escape the gravitational pull of these new machines and the business models that enable and leverage them.

As such, whether you are managing a large enterprise or just starting your first job, deciding what to do about the new machine—this new cocktail of AI, algorithms, bots, and big data—will be the single biggest determinant of your future success.

Digital That Matters

For the past decade, we've collectively enjoyed "digital that's fun." We've seen the incorporation of Twitter (2006), the introduction of Apple's iPhone (2007), and Facebook's IPO (2012). These companies, along with others, such as Google, Netflix, and Amazon, have been able to generate unprecedented commercial success in terms of customer adoption, daily usage, and value creation by changing how we communicate and socialize. Yet, history will note that we started the digital revolution with the amusing and the frivolous: Facebook posts, Twitter feeds, and Instagram photos. We are using the most powerful innovations since the introduction of alternating current to share cat videos, chat with Aunt Alice, and hashtag political rants. However, that's just the warm-up act, for we haven't yet begun to fully realize the potential of the new machines.

Technology writer Kara Swisher summed it up best when she said, "In Silicon Valley, there's lots of big minds chasing small ideas."[6] Well, we're entering an era of big brains focused on *big* ideas—*digital that matters*—using these technologies to transform how we are educated, fed, transported, insured, medicated, and governed.

While companies such as Facebook, Amazon, Netflix, and Google (sometimes known as the FANG vendors) seem to have established themselves as the presumptive and eternal winners in this space, history will likely remember them as the precursors to a much more momentous and democratic economic shift. The next wave of digital titans probably won't be characterized by start-ups from Silicon Valley; instead, it will be made up of established companies in more "traditional" industries—in places like Baltimore, Birmingham, Berlin, and Brisbane—that figure out how to leverage their longstanding industry knowledge with the power of new machines.

We're starting to see this play out as we collectively work to apply systems of intelligence to help address some of our most vexing societal ills in areas where digital technology is not just entertaining or convenient but also life-altering. Certainly, many of our institutions—the pillars of our society and our everyday lives—are ripe for improvement.

For example, worldwide we lose 1.2 million lives to car accidents annually, with more than 94% of these accidents a result of human error.[7] In the United States alone, these wrecks cost society over $1 trillion. This is

nearly one-third the amount the U.S. federal government collects in individual income taxes.[8] Driverless cars promise to save countless lives and heartache.

One-third of all food produced in the world goes to waste. The food wasted in rich countries alone is almost enough to feed all of sub-Saharan Africa.[9] By instrumenting the supply chain and applying AI, we could literally feed the world.

Medical misdiagnoses could also plummet. Right now, 5% to 10% of trips to the ER results in a misdiagnosis.[10] More than 12 million diagnostic mistakes contribute to 400,000 deaths caused by preventable errors each year, and that's just in the United States.[11] Applying data to the diagnostic process could dramatically improve patient outcomes.

The United States spends more per student on secondary education than most other countries in the world but generates mediocre results. In a recent international study, American students achieved scores far below those in many other advanced industrial nations in science, reading, and math.[12] By tailoring lessons to the individual learning style of each student through technology, we could make the education process radically more productive and effective for both students and teachers.

These are the sorts of big things that we can address with the new machine. It's digital with purpose and digital that matters, and the big brains bringing these innovations forward will not necessarily reside in Silicon Valley or an MIT dorm room. They may well be sitting in an office down the hall at your company.

For example, McGraw-Hill Education is applying new technology to help teachers and kids improve learning with a system called ALEKS. The artificially intelligent **A**ssessment and **LE**arning in **K**nowledge **S**paces system uses adaptive questioning to quickly and accurately determine exactly what a student knows and doesn't know in a course. ALEKS then instructs the student on the topics he or she is most ready to learn. As the student works through a course, ALEKS periodically reassesses the student to ensure retention. All of this results in more flexible, one-on-one instruction for students, which boosts student success. And for teachers, ALEKS helps take over some of the more routine—and, let's say it, boring—work to allow them to focus more intently on working with students. Discovery, one of South Africa's leading insurers, uses its Vitality platform to provide economic incentives—discounts on travel, entertainment, healthy food, gym

memberships, sports equipment, health products, and the like—to its members based on whether they participate in healthy behaviors. Members earn points by logging workouts with connected fitness devices and purchasing healthy food (also logged by swiping their Vitality card). The insurance sector may not be known as a hotbed of innovation, but Discovery has built a thriving business based on the value derived from the new machine.

Playing the New Game

Another area ripe for reinvention is managing our money. Jon Stein doesn't look like a Wall Street Master of the Universe—just the opposite, in fact. In his mid-30s, dressed in blue jeans and a mildly tattered shirt, he works not in a financial citadel but in a relaxed loft-like space. His language is not full of bravado and bombast but is casual, considered, and humble.

Yet Stein is turning his corner of the banking world, personal wealth management, on its head. His company, Betterment, has rapidly become one

Figure 1.1 Jon Stein, CEO and founder of Betterment

of the world's leading "robo-advisors," leveraging AI platforms to rewrite the rules of the financial advisory business. Betterment provides highly personalized, curated wealth management services 24x7. His system of intelligence is doing the work of hundreds of people and is doing it better, at a fraction of the cost.

Millions of investors—millennials, Gen-Xers, and baby boomers alike—are flocking to the platform. From the beginning of 2015 to mid-2016, Betterment's assets under management grew from $1.1 billion to $5.0 billion[13,14] and for good reason. Betterment has created a bigger pie for wealth management services because it can attract new customers that traditional banks wouldn't touch. Traditional "bulge-bracket" investment banks (e.g., Goldman Sachs, Morgan Stanley, Credit Suisse, etc.) often do not offer personalized wealth management services to anyone with less than $1 million in assets; the margin isn't there, given their one-to-one advisory business model. So where does that leave the other 99.9% of the population that is interested in having their money professionally managed?

Betterment started by focusing on HENRY (*h*igh *e*arners, *n*ot *r*ich *y*et). These are young professionals in their 20s and early 30s: lawyers, doctors, and managers starting their careers armed with great educations . . . and the associated student debt.

Traditional wealth managers won't touch HENRY, but Betterment welcomes anyone with money to invest. And as each new customer comes on the platform, the system gets smarter, providing better value to each individual participant: on the spot, empirically based, unspun counsel on investment strategy, portfolio allocation, and tax management.

Robo-advisers, collectively, have more than $50 billion in assets under management today (and are estimated to have over $250 billion under management by 2020) and are taking aim at the $20 trillion worldwide that is currently being managed by 46,000 human financial advisors at traditional banks.[15]

Now, we don't know whether Betterment will ultimately emerge as the long-term winner in this new form of financial advisory services, but the company does demonstrate how new machines are disrupting traditional ways of work. Such widespread adoption is creating shock waves in both the financial services and technology industries.

Stein, and others who have figured out the new game, are nothing short of the Henry Fords of our time. They understand today's new raw materials

(big data). They have built and now operate the new machines. And, most important, they have surrounded these new machines with business models that generate remarkable growth and profitability engines while expanding the overall market.

The story of robo-advisors in wealth management is about to be replayed a thousand-fold across all sectors of our economy. So the question becomes: Will you play, or stand on the sidelines?

But Will *I* Be Automated Away?

We have already proven that we love to consume AI-based products (with our rabid usage of the FANG vendors' offers on our smartphones). And, through digital that matters, the new machine is poised to transform the primary institutions of our society for the better.

Yet once we get over our initial awe of the new machine, we start to wonder how it will impact jobs. What will happen to all those bankers, drivers, radiologists, lawyers, and journalists? What will happen to . . . me? Will a robot take my job?

Many of us don't know whether this Fourth Industrial Revolution is very good or very bad. It all starts to feel like a capitalist's dream . . . but a worker's nightmare. And the uncertainty is creating a palpable sense of anxiety, for at a personal level, many of us don't know what to do about it.

Some see only the dark side of this shift, and indeed, many of today's headlines forecast a grim future in a "jobless economy" as robots take over our livelihoods. But the coming digital boom and build-out we describe in the next chapter will be highly promising for those who are prepared. In fact, it will usher in once-in-a-century growth prospects as we reengineer our infrastructure, our industries, and our institutions. Similar to the prior three industrial revolutions, this one will steamroll those who wait and watch, and will unleash enormous prospects and prosperity for those who learn to harness the new machine.

All of this depends on what *you do now* to prepare for an era when machines can potentially do nearly everything related to knowledge work.

Will many jobs be "automated away" in the coming years? Yes. However, for the vast majority of professions, the new machine will actually enhance and protect employment. We don't think, for example, that a single

teacher or nurse will lose their job due to artificial intelligence. Instead, these professions will become more productive, more effective . . . and more enjoyable. Workers in such professions will come to view the new machine as their trusted colleague. Just as one wouldn't think of driving across London today without an AI-based GPS, or researching a subject without referring to Google and Wikipedia, most workers in the coming years would not consider approaching their daily tasks without a "bot" at their side.

Additionally, entirely new professions will be created, driving employment in fields we can't currently envision (imagine trying to describe a "database administrator" to somebody in 1955). We have much to look forward to *if* we understand exactly what the new machine can and cannot do and how it will impact the future of work. Some very clear patterns for success have emerged, and we'll spend the rest of the book framing what's going on and providing tactical guidance on how to win in the new digital economy.

Getting AHEAD in the Age of the New Machine

We've written this book to provide you with a roadmap, a guide to success for this time of transition. First, we will outline what the machine actually is: how it's built, what it can do, and what it *can't* do. We will then look at where it can best be used today and tomorrow. What industry problems can it solve? What new customer value propositions can it create? Third, and most importantly, we will give you a structured approach for moving forward with our AHEAD model, which is based on our work with Global 2000 companies at the vanguard of the digital transition.

Briefly, AHEAD outlines the five distinct approaches for winning with systems of intelligence. The acronym stands for:

- **Automate:** Outsource rote, computational work to the new machine. This is how Netflix automated away the Blockbuster retail store and how Uber is automating away taxi dispatching.
- **Halo:** Instrument products and people and leverage the data exhaust they generate through their connected and online behaviors (what we call Code Halos) to create new customer experiences and business models.[16] General Electric and Nike are changing the rules of the game in their industries by instrumenting their products, surrounding

them with halos of data, and creating new value propositions and customer intimacy.

- **Enhance:** View the computer as a colleague that can increase your job productivity and satisfaction. The GPS in your car currently enhances your driving, keeping you on the fastest route, alerting you of road hazards, and ensuring that you never get lost. In the coming years, entire vocations, from sales to nursing to teaching, will be revolutionized with the power of computer-based enhancement.
- **Abundance:** Use the new machine to open up vast new markets by dropping the price point of existing offers, much as Henry Ford did with automobiles. In the way that Betterment is using AI to bring financial security to the masses, which market offers can be greatly democratized and expanded in your industry?
- **Discovery:** Leverage AI to conceive entirely new products, new services, and entirely new industries. As Edison's light bulb led to new discoveries in radio, television, and transistors, today's new machine will lead to a new generation of discovery and invention.

These are five specific approaches—*plays*, if you will—for winning with AI, each with its own set of approaches and tactics. In the coming pages, we will utilize this model to demystify the application of the new machine in your business.

The first play—*to automate*—is the one most prevalent in today's zeitgeist. Automation has been the initial step in each industrial revolution, as one loom replaced 40 textile workers or one steam engine had the power of 50 horses. Today, automation will be a similar necessary "evil," because it's how you will deliver at the "Google price" in core portions of your company. However, what most market observers miss is that the next wave of automation will pave the way for invention and economic expansion through the four subsequent plays.

This one-two of efficiency plus invention will manifest itself across all industries. Banking will become more efficient and personalized. Health care will become more transparent and effective, generating much better outcomes. Manufactured goods will become more interactive, intuitive, and reliable. Our food system will be less wasteful and produce higher quality goods. Education will be enhanced and individualized, and government services will be upgraded and more cost-effective. And, as outlined previously, much of this shift will not be driven by companies that were started last year or even 10 years ago but by companies started by our grandparents. This

is because those companies have access to the richest lodes of data, the "fuel" for the new machine.

Much has already been said and written about the potential impact of the new machine on society. We wrote this book not for policy wonks and academics but rather for people in organizations large and small that are trying to make the best decisions possible for their businesses and their own jobs. We aren't naïve to the fact that business happens in a wider context, but we can't all sit around waiting for politicians to improve education or to pass huge spending bills to enhance infrastructure or enact a universal basic income. We need to act *today* in the world as it is. You can rest assured that if you don't act now, others will.

The title of this book is *What to Do When Machines Do Everything*. This may sound a bit hyperbolic, and clearly machines will never do *everything* and nobody really wants them to. But in the next few years the new machines will continue to amaze, will be embedded most everywhere and in most everything, and will increasingly do more and more of the work people do today.

Technology is no longer the domain of the few but the province of the many. As such, those who win in the next phase of the digital economy are not those who can create the new machines, but those who figure out what to do with them. This book is your field guide.