THE IMPACT of AUTOMATION

Essays on the effects of artificial intelligence and thinking machines on the human experience

Bob Reselman

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FOREWORD

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As a Futurist, I appreciate the complex nature of conversations focused on automation. Bob Reselman confronts that complexity by addressing automation across multiple aspects of the topic. In his new book, "The Impact of Automation," Bob explores the societal implications of automation as it continues its unabated path. What does a world without work look like? Discussions surrounding technological unemployment have taken place for centuries. We are rapidly approaching a world where more and more tasks are coming within reach of machines. These tasks used to be far beyond the capability of computers, and yet machines are diagnosing illnesses, drafting legal contracts, writing news reports and composing music. Yes, we have been here before. Technological unemployment on a large scale has always been feared, but never realized. Alternating waves of labor substituting and complementing technologies have impacted people for centuries.

Old institutions and beliefs will not resolve the challenges ahead. We must think differently about this future if we are to realize the societal benefits that it represents, while mitigating the risk of unintended consequences. Advances in science and technology will pose challenges in the context of work, but it will also lead to solutions to some of the world's grandest challenges. Books such as this provide insight that drives dialog. It is through dialog that we come to

appreciate the challenges that must be addressed. As Bob states:

It is foolish to ignore a future in which machine automation is doing exponentially more while affecting every aspect of human employment. Yet, it's equally foolish to acquiesce to a hopeless, dystopian future in which automation takes over and most human activity is reduced to nothing more than a lifetime of watching infinite content on big-screen TVs while eating machine-produced meals delivered by intelligent robots on demand.

Gains in productivity since the first industrial revolution have driven human development. Yet debates continue as to why productivity has stalled for 25 years, with a productivity paradox that sees increased innovation in the digital age with no equivalent increase in productivity. Some economists believe that the low-hanging fruit of innovation has been picked and the benefits of previous general-purpose technology platforms (GPTs) have been exhausted. They add that recent innovations are much less significant than innovations of the past. But here we are staring at a world of automation that could take productivity to inconceivable levels. What are the human costs? Are we built for a world of leisure? Are these fears overblown? In the pre-industrial age, rulers blocked the advance of technology, for they feared societal unrest. It was Britain in the 18th century that overcame those concerns, as competitive disadvantages forced them toward productivity improvements. Are we seeing a similar phenomenon? Will nations seek to slow the pace of automation to avoid societal unrest? Will they reverse their position as other nations plow forward?

If we slow the pace of innovation, will we also slow the ability to eliminate poverty, feed a world of 9 billion people by 2050, eliminate disease, enable the disabled, etc.? These are the major challenges of the next two decades, and how society deals with them will determine

the world that emerges. Explore these and other questions in this look at automation. Our author focuses on topics ranging from isolation, employment, crime, poverty, life, death, education, trust, safety, culture, security, UBI, transportation and life after automation. Futurists around the world are predicting more change in the next 20 years than we experienced in the previous 300. The automation of everything is on the front end of that change.

Frank Diana,
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ABOUT FRANK DIANA

Frank Diana has served in various leadership roles throughout his career and has over 35 years of leadership experience. Currently at Tata Consultancy Services, he is focused on leadership dialog in the context of our future and its implications on business, society, governments, economies, and our environment. He blends a futurist perspective with a pragmatic, actionable approach, leveraging horizon scanning and storytelling to see possible futures and drive foresight into leadership deliberation.

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INTRODUCTION

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Machine automation is a historic trend that has been with us since the invention of the wheel. Windmills and waterwheels freed humans from the back-breaking toil required to grind wheat into flour at a scale large enough to feed an empire's population. Sail technology replaced human oarsmen, making international trade commonplace. Steam-powered locomotives replaced horse-drawn wagons and transported populations beyond the place of their birth to create new industrial centers. Even a piece of automation as trivial as the electric hand drill changed the face of the construction industry.

Leveraging machine technology to empower human activity will continue to be a driving force, culturally and commercially. Still, profound change is upon us. The trends of the past are converging into something different. Today we are at the frontier of the thinking machine.

This new paradigm, in which machine automation that can both think and act in the physical world, is very much a part of our present-day reality. The impact is like nothing we've experienced before. Some machine automation will enhance human activity, while other types will be our direct competitors. When machines prevail, those humans who can adapt to the new paradigm will find other types of work to bring meaning and substance to their lives. Others will simply be left behind.

The old saying that those who don't learn from history are doomed to repeat it no longer can be a beacon by which we can illuminate our future landscape. We're moving into an era of machine automation in which there is no history. It's all new. It's inspiring and frightening at the same time. It is foolish to ignore a future in which machine automation is doing exponentially more while affecting every aspect of human employment. Yet, it's equally foolish to acquiesce to a hopeless, dystopian future in which automation takes over and most human activity is reduced to nothing more than a lifetime of watching infinite content on big-screen TVs while eating machine-produced meals delivered by intelligent robots on demand.

Neither machine automation or human beings are going to go away. We're going to move forward together. The challenge is to learn how to live and prosper in a world in which machines are doing more of the thinking work every day.

This book is an examination of the impact of automation on the human experience from both perspectives, good and bad. The chapters presented in this book are an attempt to identify the issues at hand and offer solutions where possible.

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TECHNOLOGY: ISOLATION IN THE AGE OF AUTOMATION

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Dependence on technology makes us more independent overall, but it also makes us more isolated. So, what happens if things come to the point where we depend on machines more than we depend on other human beings?

Earlier this month I attended a presentation about machine learning on mobile phones at Google IO 2019. Right now Google is spending a lot of time and money developing machine learning models and capabilities that operate solely within the mobile device. No connection to the internet is required. It's a big deal.

During the presentation, the company showed a video that featured an illiterate woman in India who uses her phone's text recognition features to read to her. All she needs to do is point the phone's camera at a recipe or newspaper and the phone converts the text to speech.

I found the story inspiring as a technologist and as a human being. But it's not all peaches and cream. At the end of the video, the woman said something that gave me pause. When talking about using the technology to book a train ticket, she said, "I can book it myself. I don't need anyone's help."

There's no doubt the phone liberated her, very much in the same way that the light bulb liberated millions of other people in times past, bringing human activity forward beyond the setting sun. Dependence on a particular technology can create greater independence overall. However, I do wonder what happens when things evolve to the point where we depend on machines more than we depend on others, when we no longer need "anyone's help."

To my thinking, human interdependence is the thread that binds the fabric of a society together. The thousands of little interdependencies that make up the human experience have beneficial side effects. To get along, we learn the basic rules of civility. We learn to say "please" and "thank you." We learn how to wait in line at the DMV. We pick up after our dog. We open the door for others. It's all part of the implicit contract that makes living with other people possible.

But, these days it seems we depend more on machines than the kindness of strangers. The fact is, you don't have to be nice to a machine, even for a self-serving purpose. You can yell at your cell phone. You stick your tongue out at the ATM as it accepts your deposit. Whether you're nice to it or not doesn't matter. Your deposit is not going to be processed any faster or slower. Your cell phone isn't going to disconnect you because you were rude to it.

Take away these simple rules of civility and strange things happen. It's interesting that road rage is common, yet sidewalk rage is rare. Maybe wrapping ourselves up in a piece of silicon-powered transportation hardware predisposes us to a hostile attitude when interacting with others in the same situation.

As I stated earlier, depending on technology makes us more independent in the big picture. But, it also makes us more isolated.

Whereas in the past, talking about the weather with a stranger might be a prelude to another conversation that's more meaningful, today the stranger next to me usually has his ears plugged up listening to his own interests. And, if I really want to know about the weather, I can ask Alexa.

Modern technology gives me help on demand. I no longer ask a stranger for directions to the train station, I use my phone. It seems as if I need the help of others less during those small, random moments of vulnerability. A machine is but a voice prompt away. And, thus, the thread that binds me to the world at large gets a little bit looser.

Now don't get me wrong—isolation is nothing new. Five hundred years ago most people never traveled far from where they were born except on very special occasions. Village life is a case study in group isolation. But, while villages were isolated from the outside world, inside the village it was a different story. The social fabric was dense; the threads were tight. Being shunned by the group was a matter of life and death.

Today we're all over the place, literally. But we move in our own domains in which we end up wishing happy birthdays to people we've never met but who somehow have meaning to us by way of LinkedIn, Facebook and the plethora of other social platforms brought to life and sustained by something other than human labor.

Is this such a bad thing? Dunno. I like it that my phone is now my personal stenographer. It helps me think better. But, I'm not sure that Google Assistant will ever be a good best friend. What's even stranger is that a time might come when I don't even need one. It will be just me and my mobile device. Then I won't need anyone's help, ever.

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FULL-TIME EMPLOYMENT IN THE AGE OF AUTOMATION

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Back in 1930, the economist John Maynard Keynes wrote a short essay, "Economic Possibilities for our Grandchildren," in which he predicted that in a hundred years the 15-hour work week will be commonplace. Keynes made this assertion based on two factors: first, the increase in capital due to extraordinary yields from the compound interest that was made possible by increased foreign (global) investment; second, the growth of technological achievement made necessary by the competitive forces of capitalism and made possible by the availability of excess capital.

Keynes pointed out that these events are recent in terms of the entirety of human history, taking place over the last 500 years. Before that time, things were stagnant. Gold reserves remained static until the opening of the New World and technology, save for a few episodic breakthroughs, was pretty much unchanged. For example, the way cloth was made during the time of Joan of Arc, around 1400 AD, was not that different than the way it was made when the Roman emperor Hadrian had a wall built across northern England in 100 AD.

But, the growing availability of money and technology changed everything. By 1920, the more affluent in the population wore factory-

manufactured clothing bought in a store. Those of lesser means might still be making clothes at home, but the cloth from which the garment was made came from a factory.

Mass-market capitalism powered by technological innovation increased human productivity on a scale unique in the human experience. Abundance on a global scale seemed a real possibility within a few generations. According to Keynes,

"If capital increases, say, 2 percent per annum, the capital equipment of the world will have increased by a half in 20 years, and seven and a half times in a hundred years. Think of this in terms of material things—houses, transport, and the like."

Yet, today most people work 40 hours a week, if not more. Considering that Keynes was essentially a quant who lived and breathed data, how could he get it so wrong?

My thinking is not so much that Keynes got it wrong, but that we're having a hard time accepting that he might have gotten it right.

Allow me to elaborate.

THE FACADE OF PRODUCTIVITY

I have a theory: For the average contributor-employee in a medium- to large-size corporation (with 500 employees and more), of all the tasks he or she performs during a 40-hour week, only about half—20 hours' worth—actually add value to the enterprise. The rest is organizational overhead. Thus, there is a good argument to be made that when you do the math, what we can call real full-time employment is closer to Keynes's prediction of the 15-hour work week than not. The remaining time, which I call "organizational overhead," is really just a facade of productivity.

This theory occurred to me a while back, when I was sitting in a sprint planning meeting observing a project manager and tech-leads do task assignments. The first thing the project manager did was to determine how much time each member of the project team had available to work on the project's tasks. The agreed-upon number was 20 hours a week.

The 20-hours a week number struck me as strange. All members of the project team were completely dedicated to the project. They had no side work. The project was their one and only focus. What were they doing with the other 20 hours?

I asked the project manager and he answered, "Well, they have to do things like answer emails, go to meetings and sometimes there's some firefighting to be done."

Oh.

THE AMAZING ABILITY TO ABSORB THE COST OF ORGANIZATIONAL OVERHEAD

I wish I could say that the project manager's response was unique. But, in my experience, it's not. I've been in more than one company in which meetings, email and firefighting occupy at least half of a full-time employee's work week. And, I've got to tell you that, except in the rarest instance of mission-critical firefighting, most of these situations have marginal productive value.

Granted, my theory is based on experiences that are anecdotal. The actual numbers might prove me wrong. Obviously, a thorough, quantitative study is needed. Still, whether it's five, 10, 20 or even 35 hours a week, what's amazing is not that employees spend a lot of time in activities that have questionable productive value, but rather, that businesses can actually operate profitably despite these ongoing

time-sinks. Why? Because of automation. Machines and software are allowing people to do more work in less time—and it's not only confined to IT.

THE DIRTY LITTLE SECRET OF WORKING ON AN ASSEMBLY LINE

Doubling up has always been the dirty little secret of automotive factory work. Ben Hamper revealed the details of technique in his 1986 book, "Rivethead: Tales from the Assembly Line." Here's how it works: Imagine that you and I work in a GM plant and do jobs at the same location on an assembly line—say, putting headlights and taillights in a car. Your job is to put in the headlights; my job is to put in the taillights. One day I notice that I can probably put the headlights and taillights in a car in the same amount of time it takes two of us to do the tasks separately. So, I propose a deal to you: I'll do your job and my job for four hours a day in exchange for you doing the same for me. This way we can both work half time for full-time pay. We might have to pay the line foreman a small bribe to look the other way, but what the heck? The benefits are obvious, so we do it. Win-win, as the saying goes.

How can we pull this off? Simple: as stated earlier, automation.

Without the technology of the assembly line, we just couldn't double up. The car needs to be brought to us for us to increase productivity to the point where one person can do the work of two. The automation of the assembly line effectively reduced our work week while maintaining our productivity, just as Keynes predicted.

As you can see, the 15-hour work week is quite possible—and, in many cases, quite real. It's just that the facade of productivity, which exists in larger companies, hides its existence. But, what about the smaller companies such as construction companies, law firms, small

manufacturers, dental offices and software startups that employ fewer than 100 people? These types of companies cannot afford a lot of non-productive activity. How do these companies get to the 15-hour work week? Is it possible?

My answer is yes, but the world that will need to exist to make the 15-hour work week possible will look dramatically different than the one we have today. What will that world look like? Allow me to illustrate using my neighborhood cafe, the C&M, as an example.

THE REAL IMPLICATIONS OF THE 15-HOUR WORK WEEK

My favorite neighborhood cafe is the C&M. It's a hangout sort of place with good food, good coffee and Wi-Fi. The C&M is usually staffed by two employees during its business hours—7 a.m. to 5 p.m., seven days a week. Between them, they take orders as well as make the food and deliver it to the tables.

Let's do the math. Let's figure that the actual working day at the C&M is 12 hours—10 hours of operation time and two hours of setup and cleanup. That comes out to 84 hours a week. Thus, excluding the owners' time, the number of employee hours needed to run the C&M is 168. (two employees at 84 hours a week.) This comes out to around four people required to staff the business using the current 40-hour work week model, again excluding the owner's time.

Now, let's say the business is quite profitable and the owner can afford to pay employees $20 an hour, plus health insurance. Adding in payroll tax and workman's compensation (more than $5 an hour) plus the cost of health insurance ($400 a month, for illustration purposes), the weekly cost of each employee working 40 hours is $1,100, which translates into a total weekly labor cost for the C&M of $4,400.

So far, so good.

This time, let's interpret the C&M labor situation in terms of the 15-hour work week. To cover the 168 hours per week that the C&M is operational, at a 15-hour work week per employee, the C&M needs to employee 11 people—actually, it's 11.2 employees, but I rounded down. So, under Keynes prediction, if each employee is entitled to the established full-time compensation of $1,100 as calculated earlier, the weekly payroll for the C&M goes from $4,400 a week to $12,100—an almost three times increase, which is not an affordable number. Even though the number of employees has gone up, the odds are that the actual sales will remain the same. Instead of having to employ four people producing $14,000 a week in sales—$2,000 a day over seven days, again for illustration purposes—now the owner of the C&M will be employing 11 people to produce the same amount. Bankruptcy is imminent.

Clearly, the C&M cannot tolerate 11 people working 15 hours a week for a full-time wage under current conditions. So much for the 15-hour work week. Well, not so fast. Let's reimagine the scenario from a different angle: Suppose that the number of employees stays at four, but instead of working 40 hours a week, each employee works 15. What could we add to the mix to make this scenario possible? Give up? OK, I'll tell you: robots.

Imagine that instead of having two people on hand to set up the cafe, take orders, make the food, bring it over to tables, bus the table and then clean up at the end of the day, we had one person on hand to do what we'll call human essential work. All the other work gets done by robots. Then, the typical interaction looks like this: Customers enter orders directly into an iPad, the robotic coffee maker gets the order and makes the double espresso, a robot in the kitchen makes the

food, with the intermittent help of a human when necessary, and a robot delivers the food to the table. The one human on hand interacts with customers and picks up the slack work the robot can't do. You can think of the scenario as the restaurant equivalent of a driverless Uber ride.

Is such a world possible? Yes. In fact, it's happening as you read this article. There's already a chain of waiterless sushi restaurants in Japan. As the technology drops in price, more restaurants will make the transition.

The 15-hour work week could indeed become a real possibility provided that two conditions exist: affordable robotic technology with a high degree of manual dexterity is available, and the employer is willing to pay the higher wages necessary to support the model.

In the past, workers such as Ben Hamper used their ingenuity to take advantage of the reduction in labor that automation made possible. Sadly, such efforts were clandestine and deceitful. All that GM needed to do to realize a better return on labor was to speed up the assembly line. Yet, when you think about it, back then GM wasn't doing that badly when Hamper was doubling up. 1984 was a record-setting year in sales, despite his shenanigans. Speeding up the line would undoubtedly increase GM's bottom line. But, would it double Hamper's take home? Probably not. (Author's Note: GM's sales dropped 26 percent in 1986, but profits were still a healthy $1.06 billion.)

So here are two questions to contemplate: As companies, large and small, adopt robotics to increase productivity, will they indeed share the benefits of the increased productivity with the average worker so he or she can enjoy a 15-hour work week? And then, should the 15-hour work week indeed become standard, what will the average person

do with all this newfound leisure? As the saying goes, idle hands make fretful minds. According to Keynes:

"Yet there is no country and no people, I think, who can look forward to the age of leisure and of abundance without a dread. For we have been trained too long to strive and not to enjoy. It is a fearful problem for the ordinary person, with no special talents, to occupy himself, especially if he no longer has roots in the soil or in custom or in the beloved conventions of a traditional society."

For those of you that think about such things, I will leave up to you to answer these questions. As for me, I can't wait for the robots to take over so I can go back to my studies, full-time.

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MINOR CRIMES AND MISDEMEANORS IN THE AGE OF AUTOMATION

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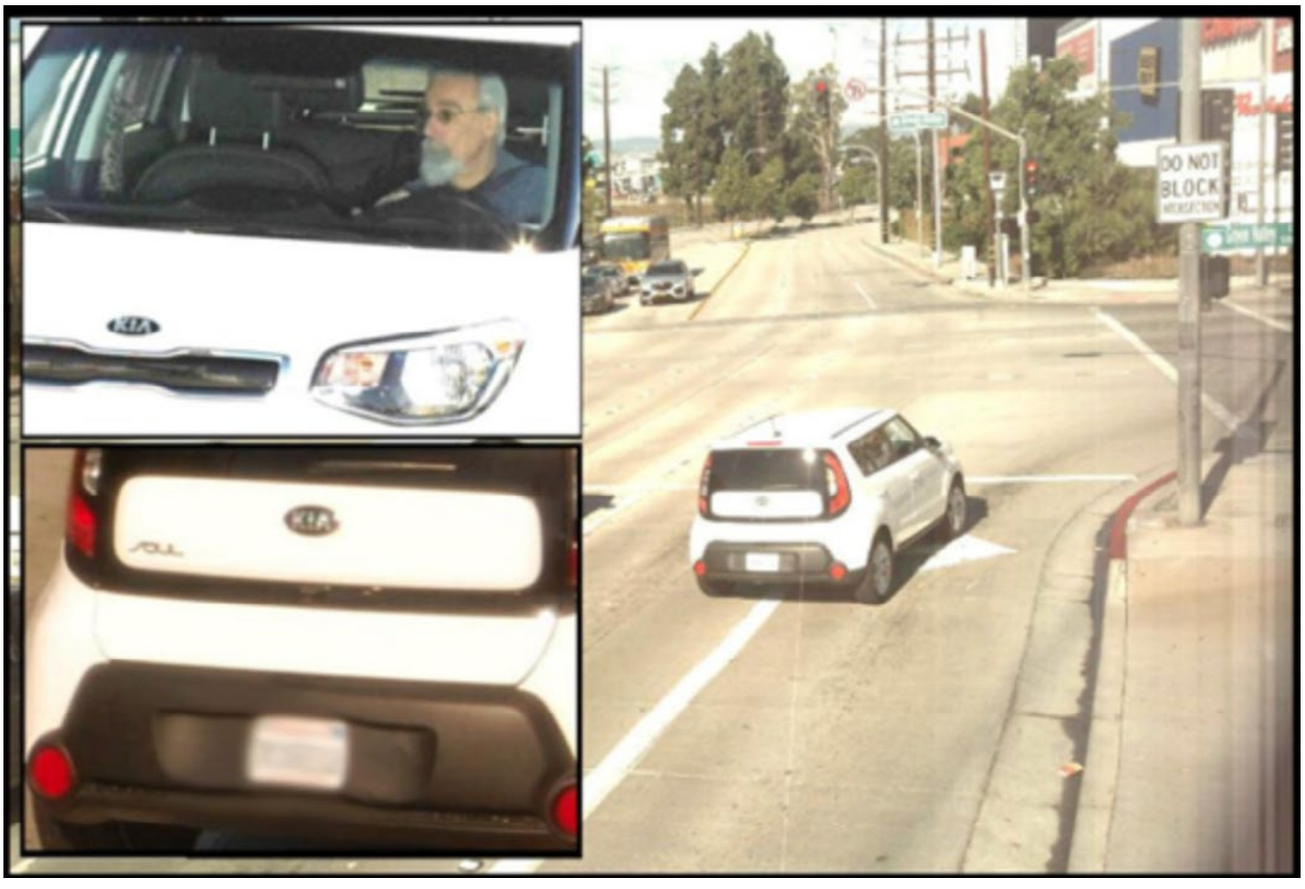
Giving automation the power to detect crime and enforce punishment has ramifications, even for minor infractions.

In November, I broke the law. I crossed over a solid white line to make a right turn at a traffic intersection. At the time I was unaware of my violation. I was on my way to a shopping mall in an unfamiliar part of town to buy my wife a gift for her birthday. My only defense is that I was following the instructions emitted from the map app on my cellphone. It told me to make a right turn. So I did. Little did I know I was being watched.



Automation enhances law enforcement capabilities

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A few weeks later, I received a citation in the mail. The citation had photos of me, my car's license plate and the car crossing the solid white line. Turns out, there were cameras at the intersection watching all traffic activity. I was busted. I was also a bit shocked: My experience getting a traffic ticket 10 years earlier involved a real police officer writing me up in real time. Now it was as if Big Brother was indeed watching.

In addition to the eerie feeling that goes with being charged with a crime anonymously well after the fact, I also felt baffled. The traffic citation did not list the amount of the fine I had to pay. The only information it provided was that I needed to go to the traffic court website to learn the details. So I did.

I logged into the website and entered my citation number. The site had no record of the ticket, but noted that it can take up to 30 days for

an automated ticket to make it into the system. I felt powerless; I was charged with a crime, liable for a fine and yet didn't know how much my transgression was going to cost me.

I decided to call the telephone number provided on the citation for more information. I dialed the number using the same cellphone that had gotten me into trouble in the first place. I was connected to an automated answering system. After navigating through various Yes/No and "enter the proper number" prompts, I learned that the system had no record of my citation. My only option was to wait 30 days for the systems to get their collective act together.

A month later, a formal citation did indeed arrive in the mail, noting the amount of my fine ($480) and options for payment. Also, the citation provided instructions to go online and pay the ~$500 required to attend traffic school, should I so desire. (Traffic school is an option in California in which you attend a one-day class about traffic safety and your violation is kept private from insurance companies. The result is, your automobile insurance rates don't go up. Here in Los Angeles, a lot of professional actors teach traffic school as a side job. As you can imagine, traffic school can be quite entertaining. But, I digress.)

At this point, I was completely bewildered. I'd been busted for a crime I didn't know I committed, by machines I didn't even know were there. The only way I could get the details about my transgression was by interacting with other machines on the internet or on the phone. And, should I decide to plead guilty and settle matters, my first, best option is to do so via automation.

Still, the technology was failing me. I needed to talk to a person, any person. So I went down to the courthouse in Santa Monica. There

I found a special window on the exterior of the courthouse building for processing traffic inquiries. (One of the nice things about living in sunny Southern California is that providing service outdoors throughout the year is a viable option.)

I waited in line. Finally, I got called forward to the window—which, by the way, was a pane of blackened glass. I had no way of knowing who or what I was talking to; all I saw was my reflection in the black mirror. A voice from the speaker at the bottom of the window asked me to state my business. I did. The conversation continued. The responses from the speaker seemed brusque, if not a bit preformulated. I started to wonder, Am I talking to a machine or a person? So I asked a random question, "How much is two plus two." The voice in the speaker responded, "Sorry I am not programmed to respond to that information."

Now I was really thrown. Was I confronting yet another piece of automation? After a minute or two, the voice in the speaker said, "I'm just messing with you. I get this all the time. They all think I'm a machine."

It turns out that the voice did indeed belong to a human, and the human's name is Dante Pipkins. Dante shared an interesting fact with me: Even though my violation was caught on camera, the actual OK to create the citation was issued by a human police officer behind the scenes. Go figure.

Thus, having been enlighted about the details of enforcing traffic law via camera, I finished my business by having Dante give me a date to appear in traffic court, before a human judge, to plead my case. I knew there was no way to proclaim my innocence. I had been caught red-handed. My intention was to throw myself on the mercy of the court to get a reduced fine.

THE POWER OF AUTOMATION

Automation is a great thing. It empowers us. It saves us time and money. Without automation, there's no AWS, Google, Azure, Digital Ocean, Netflix, Etsy, Shopify, Facebook, Instagram, Slack, Airbnb, New York Stock Exchange … the list goes on. Automation is more than a technological feature. It's now a way of life. And, for those of us who work in DevOps, automation is fundamental—none of us want to go back to the days of manual deployment and guesswork system monitoring, to say the least.

Yet, we do walk a tightrope. As my recent travails with a very minor aspect of the legal system demonstrate, automation is becoming a key factor in everyday law enforcement. On face value, this might seem like no big deal, but consider this: Today, charging a citizen with a crime is still subject to some sort of human intervention. There are a lot of details to consider that go beyond the current capabilities of AI and machine automation. Human judgment is still the most reliable form of judgment. Yet, it's time-consuming and expensive. Eliminating time-consuming, expensive tasks with cheap, fast, accurate machine-driven processes is a key motivator for using automation.

As automation becomes more familiar with the activities it is processing, it becomes an expert. And, as automation achieves expert status, it replaces human activity. Just think about detecting credit card fraud; these days, practically all of it is done using automation. While we still have a long way to go in terms of totally automated processes, automation is creeping its way into law enforcement. My recent experience is proof.

Now, imagine a world in which crimes such as tax evasion, financial fraud, embezzlement, regulatory non-compliance and yes, moving traffic violations are detected, reported and, most importantly,

prosecuted using automation. Let's go further: Let's imagine that automation becomes the default method of prosecution. Imagine that the justice system becomes so automated that the defendant is presented with an offer to plead guilty to a sentence already predetermined according to an AI algorithm. Or, the defendant can choose to opt into a human interaction but will need to bear the burden of the increased court costs, very much in the same way that an automated audio transcription service charges extra for a human to do the work.

Is such a scenario possible? Well, think about this: My interactions around the traffic violation were conducted without me ever having once had to interact with a human being. I was guilty as charged and automation proved this beyond a reasonable doubt. Not only did the technology detect my transgression, but it also connected me to my car, thus making citation possible. Hence, there's a good argument that, when it comes to automation-enabled law enforcement, the distance from catching misbehaving drivers in the act to actually going after real crooks is just not that far a leap.

So, what does this have to do with DevOps? When you scrape away all of the technological marvels, at some point there's going to be someone in DevOps either creating, deploying or fixing the systems that make this all possible. It's a big deal to give automation the power and technical wherewithal to enforce "the law." As the feasibility of putting complex, comprehensive law enforcement systems into play increases, are we in DevOps going to consider such deployments as just another day in the CI/CD pipeline, or are we going to think through the game-changing impact of what we're about to make?

For now, I'll leave it up to you to decide.

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REDUCING POVERTY IN THE AGE OF AUTOMATION

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In 1966, more than half of the people in the world lived in extreme poverty. I don't mean public housing, food stamps, subsidized school lunch, free health clinic poverty. I mean the type of poverty in which there's no electricity, no running water, no toilets and open sewers, and most children never see a doctor or the inside of a classroom. Back then, people living in extreme poverty had a daily diet of gruel; not rice and beans, mind you, but mushy, flavorless, boring gruel. Violence was rampant. Infant mortality was high and living to 65 ***was more the exception than the rule.***

While it's true that there were pockets of prosperity to be found in the Third World, for most people, if you didn't live in Australia, Japan, North America or Europe, the odds were your life was not that different from a peasant living in the Middle Ages, except that maybe you had access to a TV or radio in the village square.

CHEAP TECHNOLOGY CONTRIBUTES TO DECLINING RATES OF POVERTY

But things changed. In 1997, the number of those living in extreme poverty dropped to 42 percent of the people in China and India. By 2017, the number dropped again, this time to an amazing

12 percent in India and .07 percent in China. Now, this doesn't mean that everybody in India and China rode around in Toyota Camrys and spent their evenings gazing at a 52-inch high-def TV, but it does mean that just about everybody went to school, saw a doctor and had some choice in what they ate for dinner. It might not seem like a lot, but when you consider that their great grandmothers could barely read a newspaper, it's a big deal.

This progress didn't happen by magic, and there's a good argument to be made that it didn't happen because of politics. My opinion is that it's due in good part to the proliferation of cheap technology brought about by automation.

THE TOOTHBRUSH AS AN AGENT OF CHANGE

Small pieces of cheap technology can make a big difference. Take the toothbrush, for example. Not that long ago, a personal toothbrush was a luxury item for many. Today there are machines that make them automatically by the dozens, for pennies in material cost. Anybody can buy one and those who can't many times can get one for free. Think what it must be like for a 7-year-old child in a classroom trying to learn how to read while in the throes of dental pain. There wouldn't be a lot of learning happening.

Studies have shown that a leading indicator of good health in the long term is the practice of good dental hygiene on a daily basis. Giving a child a toothbrush and some toothpaste early in life makes a big difference. Children who brush their teeth regularly fare better. A toothbrush might seem like a trivial consumer good, but it is actually a high-impact technology that has lifted many people out of poverty.

FASTER CREDIT REPORTING MEANS LESS POVERTY

Another example of a small piece of automation that's improved the

lives of billions is credit reporting. Thirty years ago it took a few days to get the credit rating of a company, and getting the credit rating of a sovereign state could take longer. Today, getting a credit report takes seconds. Automated credit reporting accelerates financing, which not only makes it easier for a consumer to get a home mortgage or car loan, but also for sovereign states such as India to get large-scale, industrial goods such as bulldozers. More bulldozers translates into more roads; more roads lead to more commerce and more commerce leads to prosperity for more people. It's a pattern that's difficult to ignore. Just take a look at the economic growth that accompanied the expansion of the U.S. interstate highway system in the last century. In this century, the same growth pattern is underway as China grows its One Belt, One Road (OBOR) transportation infrastructure on a global scale.

THE CELLPHONE: A TOOL FOR PROSPERITY ON A GLOBAL SCALE

Which brings us to the cellphone. The first mobile phone cost $4,000. Today, you can buy a prepaid, throwaway one with service for around $50. Given the technical infrastructures required to build the phone and networking infrastructure necessary to provide service, selling a fully functional cellphone profitably at $50 is a near miracle. And, its impact goes way beyond a simple, "What time will you be home for dinner?" conversation. There's a big difference between living in poverty and living in poverty yet having a cellphone. A cellphone puts a person on the grid even when living in a hut in a remote village in Niger. Having a cellphone means being able to solicit paying work. It means having access to simple bank services. It means being able to get medical care in an emergency. And, a cellphone can connect users with online learning resources that can enhance the educational experience for those living in parts of the world where access to secondary education is rare. It's no wonder the Gates Foundation is focusing on programs that use cellphone technology to address issues in poverty stricken areas.

Not only has cheap technology reduced the cost of cellphones to nearly free, it also has reduced the cost of dental crowns through 3D printing technology and international trade through automated navigation systems for ocean-going vessels. Cheap technology also has brought about free online college courses and built-in writing assistants for email clients that have had the surprising effect of giving people better command of the written word.

THE FALL OF GLOBAL DEATH AND DESTRUCTION

Our technological achievements allow us to grow more food, educate more people and reduce the level of violence to an all-time low. Remember, 20 million Russians were killed in World War II. That's 5 million people a year over from the beginning of hostilities in June of 1941 until the war's end in August of 1945. We've not seen slaughter in such numbers since that time. Yet, news of today's conflicts is broadcasted on a global scale, so it can seem as though millions are dying everywhere. But the actual number of people killed in armed conflicts today comes nowhere close to the number casualties that were the result of the world wars of the last century.

AS THE NUMBERS GO DOWN, THE RISKS BECOME GREATER

Things are getting better for more people and we technologists have been significant contributors to these improvements. Yet, new risks are on the horizon that could stifle the upward trends. One of the biggest potential dangers is a worldwide pandemic. While cheap air travel has removed the barriers of international travel for more people, it also has made it easier for a highly contagious disease such as Ebola to spread faster.

And then there's always the risk of nuclear catastrophe. The number of nuclear weapons has decreased, but technology has made possible nuclear devices that are the size of a suitcase. Whereas it

takes the resources of a sophisticated sovereign state to create and deliver missiles capable of a nuclear strike across continents, all that is required for a non-state belligerent to deliver a nuclear blow is a small device hidden in the trunk of a car driven across an unguarded frontier. It's a remote possibility but a possibility nonetheless, and one that can have a catastrophic outcome of unimaginable dimensions. Fortunately, for better and worse, we in technology have created planetary surveillance systems that make it possible to guard against such an occurrence.

CONSIDERING THE BIG PICTURE

Technology grows in complexity every year, particularly for those of us in DevOps. The rate of innovation can be overwhelming. We've got to know more to do more. As such, many of us give most of our attention to the details that make the technology work. Sometimes we lose sight of the big picture. But, here's something to consider: As weird as it may sound given current perceptions, there's a good argument to be made that, given the increasing rate of technological innovation and the reduced costs of mainstream technology produced by such innovation, we might eradicate extreme poverty in our lifetime, if not the lifetime of our children. In the past such thinking was considered grandiose. But, as the $50 cellphone demonstrates, it's a goal we can look forward to achieving.

Authors note: The source of the data on the reduced rates of poverty worldwide described in the opening of this article comes from the book, "Factfulness" (pages 52-53) by Hans Rosling , Anna Rosling Rönnlund and Ola Rosling.

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LIFE AND DEATH IN THE AGE OF AUTOMATION

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Has automation changed the way we perceive interaction with others?

A few weeks back I got an email from an old friend, Jim. Typically, that's no big deal; I get emails from old friends all the time. Except, in this case, it was different. According to a posting on Facebook, Jim passed away about a year ago.

Another friend who is still among us reports having a similar experience of receiving emails from those who are dead. It's an eerie event that's becoming more common. Bad actors hack into a data store and pull up some email addresses, which they blast about nefariously to unsuspecting recipients. It's a strange, almost morbid experience when you're on the receiving end.

But it's gotten me thinking: What does it mean to be alive on the internet? And, more importantly, how much of what we perceive on the internet as a human really is? Jeepers—for all I know, the Facebook post could have been a ruse. Maybe Jim uploaded his consciousness into eternity and he really is trying to make contact. How would I know it otherwise?

Allow me to elaborate.

TECHNOLOGY THAT CAPTURES THE MOMENT

Mankind has been using technology to represent reality since early caveman figured out how to draw pictures of hunters and animals on the walls of caves. The more real a depiction seemed, the more valuable it was. A sign of significant wealth was having the wherewithal to pay an artist to paint your portrait. The painting passed your likeness onto future generations. Your posterity knew what you looked like. The poor just drifted in away into imageless anonymity.

However, whether you were rich or poor, there was one thing that technology couldn't do: It couldn't capture the moment. A painting took weeks, maybe months to complete. And, no matter what, the rendering was an interpretation.

Photography changed all that. It captured the moment, which was a first in human history. And it democratized portraiture. In practically no time at all, it seemed that just about every town and city had a photography studio. Affordable photography made it so images of mothers and fathers could be passed on—future generations had a very clear idea of what great-great-grandma Mary and grandpa William looked like.

Portraits of George Washington left a lot to the imagination. Photographs of Abraham Lincoln left no doubt.

Figure 1: Portraits of George Washington are renderings of the artist's perception created over time, not in the moment. *Photos © Richie Lomba*

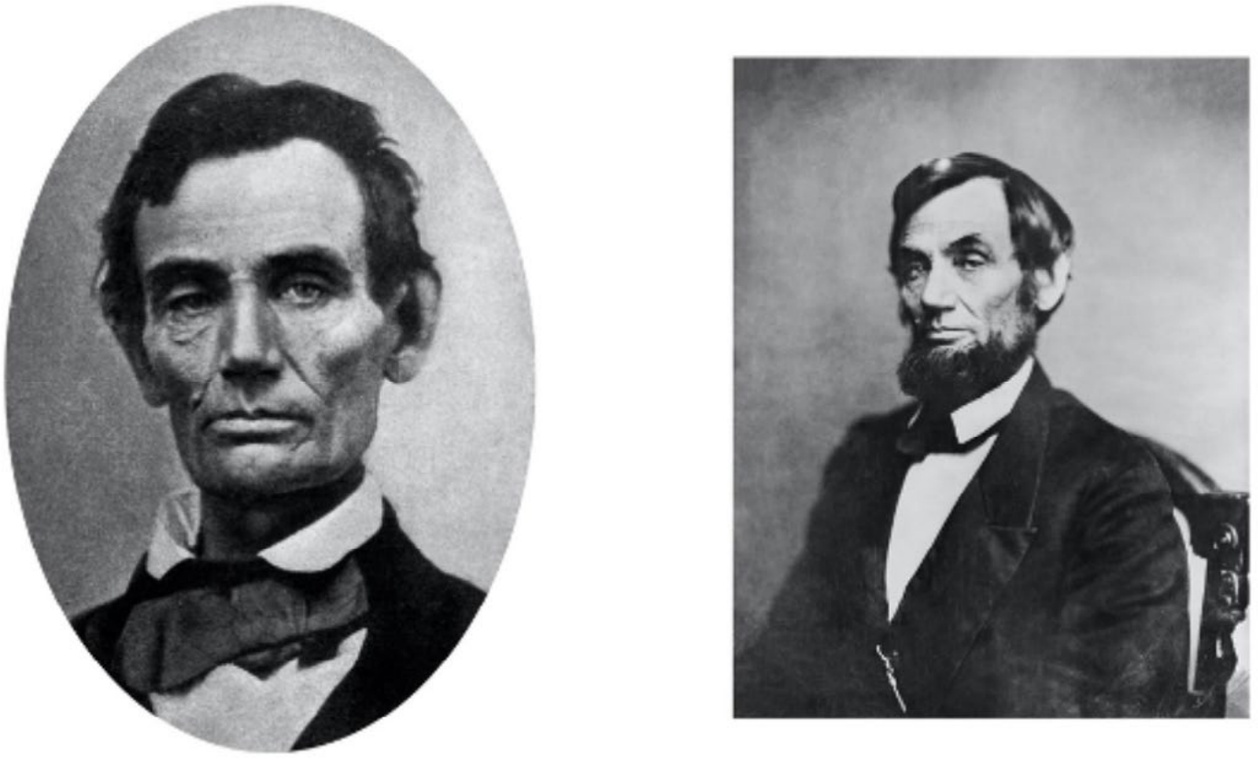

Figure 2: Photographs capture a moment in time. Abraham Lincoln in 1858 (left). Abraham Lincoln in 1861 (right).

The first time that 19th century former slave, abolitionist and author Frederick Douglass had his photograph taken was in 1841. By the time of his death, he was the most photographed man in America. Douglass understood the power of the technology both in terms of information representation and dissemination. Photographs of Douglass made his humanity real at a time when a good portion of the population of the United States was deemed subhuman.

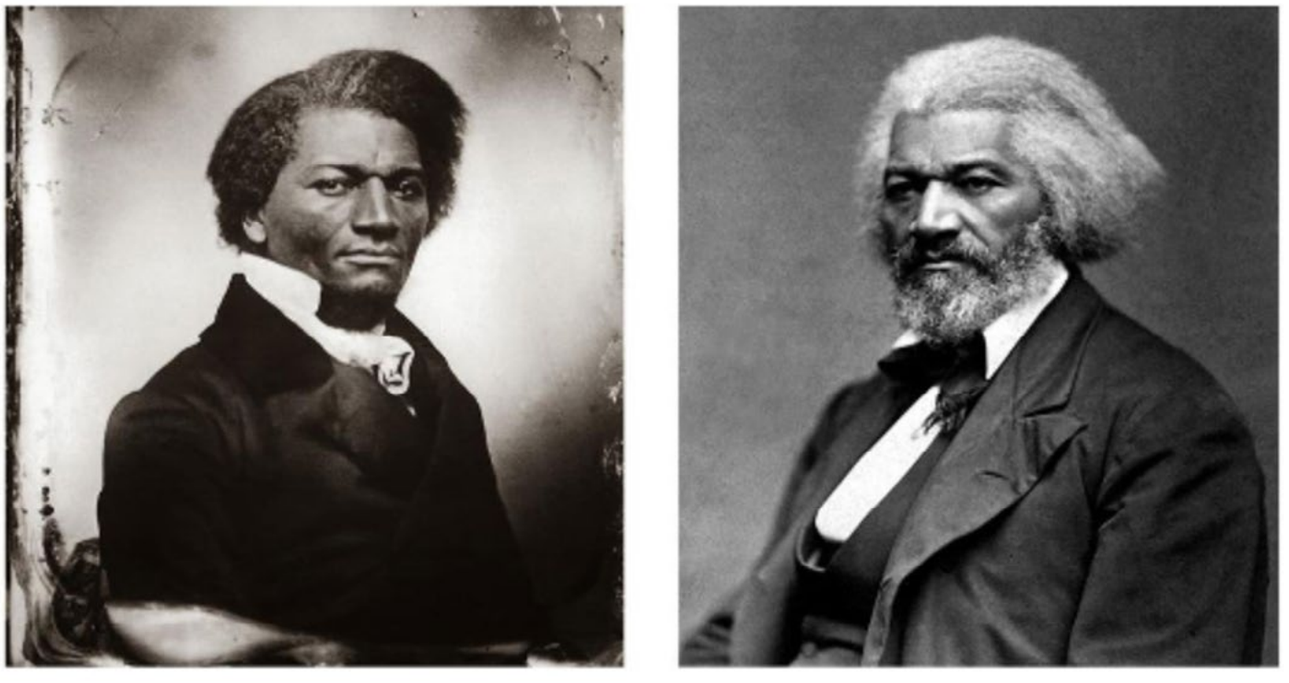

Figure 3: Frederick Douglass, born a slave, was the most photographed man in 19th century America. The reality that the technology revealed confirmed his humanity.

The power that photography brought the technological and cultural landscape created trust in the image. The veracity of information in a newspaper article could be argued, but the image the camera captured represented reality beyond a doubt—at least until the practice of doctoring photos to misrepresent reality came into practice.

REINCARNATION AS SEEN ON TV

And then came television, which made it possible to represent reality as a stream. Whereas a photograph captured the moment, television captured as many moments as the viewer had to spare. But, it was a trade-off. Television distorted perceptions of life and death. Before TV, no child ever had the experience of viewing an actor portraying a character who died in an episode of "Gunsmoke" one week, only to reappear as another character on another TV show the following week. Death became impermanent. Also, the line between fact and fantasy blurred. The same television screen that brought the nightly news also delivered episodes of "Star Trek."

In terms of time and space, the only "real" thing is the TV set. Everything else is content. Sometimes you could tag the content as "fact" and other times as "fiction." Or, you could tag it to a third category, "I'm not sure," which gave rise to the harebrained idea that the 1969 moon landing really happened in a TV studio at a secret government location.

Now, here's where it gets really interesting. In the past, most people interacted with others most of the time in close proximity. You went to Grandma's house for the holidays. You bought your groceries at the neighborhood supermarket. You sat in classrooms under the supervision of one or many teachers for at least 12 years, maybe more.

That was then and this is now.

Today, visiting Grandma for the holiday might be nothing more than a call on Skype. More people are making essential purchases online. The online class is replacing the brick-and-mortar school building.

The fact is, we're spending a lot of time in an environment that is essentially representational. Every day, more of our interactions with the "world" take place on the screen of a smartphone, tablet or a desktop computer. In some cases, it's nothing more than talking to a device by name, as in "Alexa, what time is it?"

IS IT HUMAN? DOES IT MATTER?

And thus we have the problem of distinction. We're at the stage now where we've come to accept that some of the interactions we have online might be with a human and some interactions might be with a machine powered by AI. Sometimes it's easy to tell. After all, I know there's is no miniature person living inside my Echo device. And I know there is no little man inside my refrigerator who turns on the light as I open the door. This is low-hanging fruit; it's obvious what the machine is. Still, in the long run, how can we tell? And, even if we can't, does it matter?

These days I have a lot of interactions with people on video conference and on the phone. I estimate that of all the people I interact with regularly, I've shaken the hand of about half. Twenty years ago, I physically touched nearly all. Such is the way of progress.

I've had the benefit of living in a time in which the person came before the photograph. Now, we live in a time in which the photograph can come before the person. We think up the ideal actor and send it over to the special effects department for rendering. Today, we interact with images that have no human origin and yet behave in a way that is indistinguishable from a human. For those born today, it's entirely possible that most of the meaningful relationships they have throughout their lifetime will be with non-human intelligence. Yes, there is a good argument to be made that people will still gather together in real time for concerts, religious services and sporting events. But consider this fact: 73,000 people attended the 2018 Super

Bowl in a stadium, in real time. However, 103 million watched the event on TV. The "attendance" at the digital representation of the event exceeded the real-time experience by more than a factor of 10. And, companies paid millions of dollars for advertising time during the televised game. Today, that which we perceive as real is just as meaningful as that which actually is real.

Which brings us to life and death in the age of automation. Unless Kurzweil proves right and uploading ourselves to a computerized host becomes possible as the Singularity approaches, all of us will die. And yet the images, both the ones we make and the ones that were made for us, will live on forever. Will these images take on a life of their own? Will we be able to use artificial intelligence to inject these images with the behavior that made us us, using information about us that was gleaned by observing every aspect of the online interactions we had over our lifetime?

I'm not sure. But the possibility has stopped me from replying to that latest email from my friend, Jim. To be honest, I'm afraid of what would happen if I did.

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EDUCATION IN THE AGE OF AUTOMATION

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Automation is changing the nature of education and the ways people learn. More schools are using online learning to supplement in-class activities. In fact, some schools are completely online. Distributed computing on the internet and the automation that drives it makes this possible.

Everything changes when the formal education process becomes embedded in the internet. Courseware delivery becomes asynchronous; people learn what they want, when they want to. Test administration becomes more about the efficient acquisition of data and evaluation thereof. Human-to-human interaction as a basis for a meaningful educational experience becomes optional. Today, it's entirely possible to learn all you need to know to make a good living in the modern world without ever needing to sit in a classroom or interact with a human directly. Let's face it: You can do a lot of learning from YouTube.

As a result, more people are beginning to question the conventional wisdom of spending four years and thousands of dollars to get a bachelor's degree—particularly now that companies including IBM, Google and Apple no longer require one to get hired.

Coincidentally, as companies eliminate the college degree

requirement for new hires, we're seeing significant growth in technical bootcamps. One study reports that this year, 20,000 students will complete a course of study at a coding boot camp and be "job ready." Considering that the number of students who graduated with a computer science degree from a typical college in 2017 numbered about 93,000, there's a good case to be made that boot camps are siphoning off a number of students that otherwise would be headed to academia.

Going to boot camp instead of college is an upward trend: The study projects that the number of boot camps are expected to grow 20 percent this year. The career path for a technical professional does not necessarily involve going college. Going to a boot camp for a year—if not less—will suffice.

Is this a problem? I'm not sure. On the plus side, I am reminded of the scene in the film, "Good Will Hunting," when Matt Damon's character Will Hunting, a genius with a photographic memory who walked the halls of MIT working as a janitor, makes the profound remark:

*"... you dropped a hundred and fifty grand on a f****** education you coulda got for a dollar fifty in late charges at the public library."*

There's a good argument to be made that when it comes to getting a good paying job, the $15,000 median price tag for attending a coding boot camp has a better much better ROI than spending ~$200,000, the cost of a four-year degree from MIT.

But then, I am reminded of Aldous Huxley.

In his book, "Brave New World," people are grown in test tubes according to a specific formulas, the result of which is a biological

caste system. Those in the Epsilon caste are grown to be 3 feet tall and abhor the outdoors. Their job is to work their way underneath the machines on the factory floor to do simple maintenance. Deltas, the next caste up in the hierarchy, do the menial chores—janitors, for example. Gammas are the bookkeepers and data entry clerks. Then you get to the higher levels, Alphas and Beta. Betas are technicians who do very sophisticated jobs, such as mixing dangerous chemical together. One mishap can result in an explosion, killing all. Finally, at the top of hierarchy are the Alphas. Alphas possess advanced analytical skills and a broad knowledge base. They are able to plan and strategize. They have a high degree of creativity. Their role is to run the society.

Thus, I have a concern about the increasing role of technology and automation education, and the emergence of tech-focused boot camps as the prime post-secondary educational experience for many.

As more of those entering the workforce forgo a formal college education, we run the risk of creating a society in which most of the technical workforce is Betas. They're able to do highly complex tasks, yet have no idea why they're doing them.

Let me be specific. Let's talk about Kubernetes: It takes a lot of knowledge and experience to be good at getting Kubernetes to work. It's a complex, evolving technology that you need to keep your eye on. Companies are spending a good deal of money making sure their IT staff are competent with Kubernetes—as well they should be. One little misstep can result in the digital equivalent of a chemical explosion. Yet, I wonder how many of those "working Kubernetes" are thinking about the bigger picture—for example, the purpose and value of the enterprise using Kubernetes. Are these engineers questioning if the technology they're working is doing good or harm?

Or, let's turn the dials down a bit and ask a question that's less loaded philosophically. How many of those working Kubernetes today wonder if an alternative orchestration technology such as Docker Swarm might be a better choice to meet the need at hand. Or are they so concerned with getting Kubernetes to run that they don't have the bandwidth to think about anything else? Do they just defer such critical thinking to "the system architects"?

Critical thinking, although an acquired skill, is not one that's new on the cognitive landscape. It's been taught for thousands of years, since the time Socrates sat under an olive tree asking simple questions that forced his students to transform their assumptions and allusions into thoughts based on reason and reflection.

Developing the ability to think critically traditionally has been one the aims of a college education. The romantic ideal is that college is the place where students are exposed to a variety of ideas from a variety of viewpoints. The hope is that such exposure, along with instruction aimed at developing one's ability to engage in higher-order thinking, will create graduates who will contribute to making a better-functioning, more prosperous and more humane society.

But, that's the traditional perception of college. The reality is changing. Maybe college is just the place you go to get the skills required to get a good job. If that's the case, given that a college education is becoming less affordable to more people, maybe the boot camp approach is best. Yet, there is a risk.

A good while back when I was considering enrolling in a doctoral program, I attended a required orientation at Harvard University. I sat in an auditorium composed of about 50 aspiring doctoral students. One of the department heads on stage said the following, "The objective

of our doctoral programs is simple. We want to train you to run the world."

Yep, that's right. And, I can say with a good deal of confidence that this objective is the same today—to create thinkers who have the skills and knowledge necessary to run the world. The Alphas, if you will.

So, we're at a crossroads. Automation is a liberating force in education in that it makes infinite knowledge available to anyone who wants it at a fraction of the cost of a traditional college education. All that's required is the time and desire to take advantage of the opportunity at hand. However, if the result of such education is a workforce in which the concern of most is to ensure that the technology works and does not blow up, then the risk we run is that bigger decisions will be made by those who had the time and money for an increasingly elite education. In other words, as more people spend time focused on turning the dials and setting the levels to make the technology go, a very small minority actually will be determining the purpose and direction of the machine the technology supports.

Still, the fact is, most of us need to make a buck to survive. This means being good at getting the tech to work. Yet, we will do well to understand that there is a Big Picture and if we don't pay attention to it, someone else who has been educated to run the world will.

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HARDWARE IN THE AGE OF AUTOMATION

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There's a joke making its way around the internet that goes like this:

Q: How do DevOps engineers change a lightbulb?

A: They don't. It's a hardware problem.

The trend to abstract hardware away from the day-to-day work of most IT personnel continues. We in DevOps have given it a name: infrastructure as code. Hardware has been pushed so far back into the recesses of IT that I'll wager good money to say that today most folks working in information technology have never seen the inside of a data center, and fewer have done something as labor-intensive as run cable wire over a rack of servers. For many, hardware is but a concept that's made real every month by a bill from Amazon, Azure or Google Cloud.

But hardware is real and it does matter, a lot. If you don't think so, look at your cellphone. That little piece of hardware had changed just about everything about how the world works today. The cellphone has made possible not only Tinder, Twitter, Instagram, Uber, Lyft and a multitude of startups that will never see an IPO or private equity

buyout, but it also has brought earth-shaking events such as the Arab Spring, Brexit and SpaceX landings into the palms of viewers worldwide.

Hardware counts and it's going to count more in the coming years. Those working on the forefront of innovation understand that special hardware is, and will continue to be, a critical factor in the development of increasingly complex software. We're already seeing the ability to choose specific hardware configurations available on cloud providers such as AWS. For example, the g3.16xlarge EC2 instance type is backed by both CPU and GPU chips. This is only the tip of the iceberg.

According to Jacob Smith, senior vice president at Packet:

"People ask what's next. Well, this stuff [GPUs] is an example of what's next. It's not just really expensive stuff, but really specialized stuff. Whenever you start to do something that's really big and really important, which are a lot of the things we're doing on the internet and in the world, whether it's bioinformatics or cars driving themselves, those require really big workloads. There's a lot of data, a lot of processing and you just can't do it with generic hardware. The reason that hardware is the next innovation layer is because of all the software you guys have been writing to make software portable and deployable around the world in minutes, now the software wants to touch on the new kinds of hardware. And I think that embracing this is the next wave."

Packet, and companies like it, are looking forward to a time when computing platforms will move beyond the generic to the specialized. We're already seeing the trend play out: The value of the stock of Nvidia, a major GPU manufacturer, has gone up 10x in the last three years. (See Figure 1.)

Figure 1: Nvidia stock has grown 10x in value in over the last three years. *(Source: The Wall Street Journal)*

Also, the projected demand for specialized chips is attracting a lot of venture capital (VC) money that's funding startups such as Cerebras, Wave Computing and Graphcore. Even Google is getting into the specialized hardware business with Tensor Processing Units (TPU). Hardware is indeed becoming very cool again.

So, what does all of this have to do with automation?

Automation is a processor-intensive undertaking. And, as AI weaves itself more into the fabric of day-to-day data processing and machine learning, we're going to see more demand for specialized hardware to handle the activity. In a way, that's not new; we've had specialized hardware for a while now. TV remote controls have been around well before Bluetooth came on the scene. What is new is the degree of intelligence at play in these new devices. All my old-style TV remote control had to do was change the channel when I clicked the button. Today, my remote control recognizes my voice and helps me find a show of interest. It's a big leap from an operation that responds to a button-click to one that uses voice recognition and inferential lookups.

As Packet's Smith pointed out above, as the complexity of software grows, so, too, will the need for special hardware to drive it. The new

trend will be to wrap hardware around software. Thus, I have no trouble imagining a new type of hardware that is designed to handle a very particular process—gene editing, for example. Imagine ingesting a pill that is really a nanodevice that contains the intelligence to travel your body and physically alter your genetic makeup. It's not that far-fetched an idea. Making the idea a reality isn't so much about the software, it's the hardware. We don't have the nanotechnology—yet. Hence, the opportunity.

Right now, most automation activity is run on generic chips housed in remote data centers around the world. A lot of the work we're doing is still commodity: Spinning up Kubernetes clusters, facial recognition under Tensorflow, discovering security vulnerabilities using Macie, for example. Yet, as artificial intelligence (AI) becomes more commonplace, the use cases for which AI is appropriate will grow. This growth will require new types of specialized hardware. Engineers will imagine the software and then design the hardware to make it run. We'll come to a point, which is not that far away, where innovation will be as Smith describes. It will indeed be about wrapping hardware around software. As a result, we'll go from the "Internet of Things" to the "Internet of Really, Really Smart Things, from the Microscopic to the Gargantuan." The implications will be profound.

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THINKING ABOUT THE FUTURE IN THE AGE OF AUTOMATION

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Let's do a thought experiment.

Let's imagine a world in which almost all the work required to sustain human life on the planet is performed by intelligent machines. Think about it: All the crops get planted, raised and harvested by robots. Same for livestock. Machines make all the clothing and build all the houses. People and things get transported by driverless vehicles on the ground, over the oceans and in the sky.

Food gets delivered by an AI-controlled fulfillment service that brings groceries right to the front door. Refrigerators and storage cabinets are smart enough to request replenishment when supplies run low. Packaging and containers are IoT devices that integrate easily with refrigerators and storage cabinets. Everything is communicating everywhere all the time.

Power sources are installed and maintained by robotic intelligence, some of which are supervised by a small cadre of humans. Power is delivered by AI, too. Most power is supplied by solar and nuclear energy. Given the high energy yield-to-weight ratio that fossil fuel and biofuel provide, internal combustion engines still power most aircraft.

Humans login to online schools where the curriculum is designed by AI. Lessons are delivered by AI, too, and the teaching AI is equipped with nice, supportive voices. Each lesson is custom designed to the needs and ability of the learner. Progress is monitored minutely and reported back to interested, authorized parties at regular intervals—mom, dad and the university. Some school systems provide community centers where children and teenagers congregate to learn and practice basic social skills.

Everybody's DNA is registered in the cloud. Medical services are provided online. People are connected directly to a diagnostic cloud via a variety of fitness devices and smart apparel that constantly monitor the patient's body, including but not limited to heart rate, blood pressure, lung capacity, daily calorie burn and current body fat index. The devices are smart enough to get blood samples painlessly on demand and then do perfunctory analysis in real time. More complex procedures are administered at a medical center staffed by robots expert in a given procedure, from administering a colonoscopy to resetting a broken bone or performing a liver transplant. A few highly educated, highly trained humans staff the medical centers to handle edge cases beyond the capability of current AI/robotic technology.

Economic productivity is almost completely separated from human labor. Intelligent robotics continue to be the most efficient way to fuel the economy. Human purchasing power is determined by a combination of market-driven forces and social support systems. Those few who have the motivation and skills required to participate in the workforce are compensated for their activities. Such work requires a high degree of education, intelligence and creativity to do the inquiry, analysis and synthesis needed to provide economic value. Their compensation is quite luxurious. Those who are not in the workforce are provided with the purchasing power necessary to

acquire the goods and services that are needed for a comfortable life. People who have inherited wealth live a life of luxury, too, for as long as they can manipulate their purchasing power to maintain or increase their wealth. Some wealth is still so immense that it's inexhaustible.

Crime exists in varying degrees, going up and down at predictable levels. All human activity is observable in the public space. Most humans allow parts of their private space to be monitored in exchange for some type of compensation.

Policing data is analyzed continuously to improve crime prediction models. Humans perform law enforcement activities with the help of robotic assistants. The robots confront armed assailants. The humans supervise. Transgressions such as moving violations and drunk driving are rare, as most transportation is driverless. Violent crime still occurs—always has, always will. Persons exhibiting extreme criminal behavior are isolated in prisons that are run by robots who are supervised by well-compensated humans. Administering justice is still a human activity, as is politics.

Warfare continues, but with fewer humans acting as belligerents. Warring states as well as non-state actors assault each other using physical robots that serve as an extension of the combatant. Cyberweaponry is powered by bots, but most weapons are controlled by a human operator. One human can control hundreds of weapons. Some weapons are self-directing, using artificial intelligence that can interpret predefined assault plans and act accordingly.

Governing policy is created by artificial intelligence under the supervision of human oversight. AI creates legislation based on information gathered from data streams. One stream is data provided by analyzing the behavior and condition of the population. The other

stream is polling data. Humans increase their purchasing power by participating in frequent polls administered by government agencies. The authenticity of polling data is verified directly against the DNA of the contributor.

The daily activities of most people are to consume content from the internet and play interactive games either with other humans, AI endpoints or a combination of both. Also, most people use shared assets for amusement; for example, riding a motorcycle or skiing at a resort. Some of the shared assets are owned by individuals. Most are owned by multinational corporations.

Movies are still popular. Some movie scripts are created by humans with AI assistants. Most movies are produced by pure AI, according to deep analysis of the past viewing behavior of a wide variety of audiences. Movies that are custom-designed according to the profile of the particular viewer and produced on demand continue to grow in popularity. Most of the actors in the movies are human emulations designed by AI.

Sports such as baseball, football, soccer and basketball struggle for fans as spectatorship grows in the online gaming sector. Online gambling is still popular, as is the lottery. However, participants cannot use standard purchasing power to gamble. Rather, a special recreation token, considered an extreme luxury item, is used. Lottery tickets are available for free—one per person for a monthly drawing. The winner is compensated luxuriously.

THE STUFF OF SCIENCE FICTION? NOT ANYMORE

If you've gotten to this point—and I hope you have—you might be thinking that the fully automated world I describe above is pure fantasy, a pipe dream, science fiction. It might be, but let's go through the items.

First, in terms of agriculture, in 1790 90 percent of the U.S. population was made up of farmers. Today, the number is around 2 percent, yet production far surpasses 1790 levels. How? Automation.

As far as robots making clothing, check out the Jaeger Rapier Weaving Machine: It makes cloth in 45-foot widths. Also, check out the video from the *Wall Street Journal* that describes using robots to replace garment workers in Bangladesh.

In terms of transportation, it's not a question of if driverless vehicles will dominate the roadways of the world. Rather, it's when. Also, IEEE is reporting that crewless container ships are on the horizon. Norway's Yarla Birkeland is already here.

Flying is already highly automated. Other than takeoff and landing, human crews serve more as a safety backup in case something goes wrong in flight. In the military, attack drones are still manned by remote human crews. But, again, the humans are there more for fail safety than operational purposes. Flying may never become a solely automated undertaking, but keep in mind that it takes only two humans to operate an Airbus a380, which can seat 850 passengers.

Amazon and Walmart are already in the food delivery business. Right now, it's a safe bet to assume that a human is doing the delivery. But, given the dramatic improvement in delivery robots, how long will it be until that whole process is run by a machine? Also, LG makes a smart refrigerator that provides many of the food provisioning services described above.

Oh yeah, did I mention that China is presently collecting DNA samples, fingerprints, iris scans and blood types of all residents in Xinjiang between the age of 12 and 65? We're talking millions of

people. Granted, China is not a poster child for respecting the privacy of the individual. But, let's say that here in the United States there was an offer to give anybody an ancestry report for free in exchange for a DNA sample—or, if "free" proved to have little motivational value, the offer was for $100. People sell their blood for a lot less.

Robotic surgery is real. Right now the robot is an assistant to the human. But, as we've seen with the progression of other technologies, allowing surgical robots to have increasing degrees of autonomy is only a matter of time.

In case you're wondering about the real future of warfare, according to an article on the BBC's website, "As early as 2005 the New York Times reported the Pentagon's plans to replace soldiers with autonomous robots." Interested in a high-powered robotic machine gun that can hit a target 1.5 miles away in the dead of night? Check out the Super aEgis II, manufactured by DoDAAM.

I could go on and on, but I won't, tl;dr and all that. Still, given the current rate of technical achievement, when you look at any of the scenes I described above, it's not difficult to suppose that everything I imagined is very possible. From where I sit, we're just not that far away from the endgame: AI and robots replacing most human labor in the economic sphere.

So, what's the missing link? What's it going to take to make sure that, as human labor is replaced and never to return, purchasing power is still maintained? The first step, of course, is to have some reasonable articulation of what that path to a positive outcome can look like. Fortunately, there's a good deal of thinking going on about the topic. I'll share a reading/viewing list at the end of this article.

But. more importantly, it seems as if no one in government is really talking about the inevitability of the dominance of AI and robotics or the consequences thereof. The powers that be are frightfully ignorant about what's to come. I have yet to hear the words, "We need to start anticipating the consequences of a highly automated society," come from the mouth of anyone in government. This needs to change.

It's a serious issue. Today, the impact has been felt mostly factory workers, here in the United States and worldwide. When it really hits, when all professions are subject to replacement—which some estimate to be within the next five years—the shock will be overwhelming. Then, unless government "gets it," the best recourse is to own a lot of stock in pharmaceutical and cannabis companies, because most people will need to be anesthetized to their environment to tolerate the social and economic breakdown on the horizon. Or, we can start planning to work toward a future in which ubiquitous automation provides not only a luxurious life for a few but a comfortable life for the rest of the population.

As for me, I wish we were planning.

READ AND LISTEN TO MORE:

Book: "Rise of the Robots," by Martin Ford

Book: "The War on Normal People," by Andrew Yang

Video: "Humans Need Not Apply"

Video: "Obsolete by 2030"

Podcast: "Andrew Yang and Sam Harris Discuss Universal Basic Income"

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COMING APART IN THE AGE OF AUTOMATION

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One of the fundamental tenets of DevOps is that working in closed, departmental silos is counterproductive for creating quality software. Rather, work is done best when groups are composed of members from across the business working openly and cooperatively. Experience shows time and time again that open, multifaceted teams made up of a variety of viewpoints work better than ones that are closed and monolithic.

Yet, when we move beyond the landscape of DevOps into American society, things look different. In his book, "Coming Apart," published in 2012, author and political scientist Charles Murray makes the following point: Sixty-three percent of the population of the United States—white Americans—is separating into a two-class structure in which one class enjoys an increasingly stable, healthy, knowledge-driven prosperity while the other experiences declining wealth, health and educational achievement accompanied by a loosening social cohesion. This loss of social cohesion perpetuates the continuing decline. And, there is no relief in sight.

Murray points out that while class distinction in the United States is nothing new, what is different now is that these two classes exist in silos that are closed and disconnected. While in the these past classes

have intermingled, now each lives apart from one another—so much so that the classes have become almost unidentifiable to each other.

For example, back around 1960, it was entirely conceivable that a CEO of a manufacturing business shared many of the same experiences as the less-wealthy employees of the company. They might go to the same restaurants, watch the same TV shows and maybe even drive the same make of car. Their children might attend the same schools. Today, however, it's each to his own; shared experience among classes is becoming more rare.

There definitely was a class system in force onboard the ocean liner Titanic. The well-to-do traveled first class, while the poor went down to steerage. But everybody boarded together, and Leonardo DiCaprio's pauper character had a slight chance of interacting with Kate Winslet's wealthy socialite—maybe even fall in love and get and stay married. And, when the ship went down, all aboard were at risk, rich and poor alike.

Today, the average Joe flies in a cramped seat in economy. The CEO flies private. The economy flier probably has no idea what it's like to board a private plane, let alone fly in one. The thought of packing a lunch beforehand to save money while traveling is completely foreign to the CEO. Each lives in a world the other can't imagine. Again, this trend is not reversing.

WHAT DOES THIS HAVE TO DO WITH AUTOMATION AND DEVOPS?

Tech culture is a prime example of this exclusive segmentation and clustering according to class. The average salary of a DevOps engineer is ~$138,000 a year, which puts the profession in or around the top 10 percent of wage earners. And, just getting hired at most tech companies requires a college degree. This is a self-selecting dynamic. Birds of a

feather fly together: People who make six figures tend to hang out with others who make six figures. Likewise, people with college degrees tend to hang out with others who have college degrees. If you're in tech, chances are you do not know many people in your day-to-day life who had difficulty in school, have worked on a factory floor or smoke cigarettes. When you and those around you make money by thinking, it's difficult to have empathy for those whose muscles ache after spending each day stocking shelves at Walmart. You just can't imagine it.

Intrinsically, such homogeneity is not bad. The cause for concern is that now, once the boundaries are set, it's difficult to go beyond them. In the past, the prevalence of shared experiences made moving up into that other, affluent world possible. Today, however, it is becoming nearly impossible. And we in tech are not making it easier. Why? One reason is automation.

Automation replacing human labor is nothing new. It's been going on since before Otis figured out how to make elevators go up and down between floors without requiring human intervention. Yet, this is simple stuff by today's standards. As automation becomes more sophisticated, the degree of smarts required to work in an environment in which automation prevails grows. An engineer capable of refactoring a piece of software that does speech-to-text transformation has had significantly more education than a stenographer—which, by the way, is a profession automation is replacing.

Automation is making it more difficult for those with only a high school education be employed. Yes, some sources claim that automation will actually create more jobs. But, how many of these new jobs will require nothing more than a high school diploma? And, once hired, how long will these new jobs be available before they are replaced with another piece of automation?

Now, combine this trend in automation with Murray's assertions about the growing extreme in class separation. One group is happy, healthy, pretty wealthy and productive. The other group stagnant, poorer, in ill health and continually being replaced by automation. Add in another troubling statistic: The rate of divorce in the happy, healthy, well-educated group is going down. The divorce rate in the other group is going up. (Page 146, Coming Apart, Murray) In addition, the number of single parent households among the less educated group is increasing, while the rate of single parent households for the happy, healthy, wealthy group remains low and substantially less than the other. (Page 159, Coming Apart, Murray). One group has the stability necessary to promote health and wealth in its offspring. The other group is barely keeping its head above water with little hope for better life now, and for generations to come.

What does this mean? It means that things are coming apart.

Probably one of the most important lessons we've learned in DevOps is that open systems, genuine accountability and blameless reflection combined with a cross fertilization of ideas between different groups makes for a better, more productive work environment. This thinking can and does go well beyond software. Anybody who has experienced the waste and frustration of a closed, siloed organization understands that open is better. We in DevOps understand the the smarter we all are the better off everybody is. Sharing knowledge and expertise is not a zero sum game.

According to Murray, we are no longer all passengers on a common ocean liner. Today two ships are sailing side by side. One has an able crew with enough supplies and lifeboats for everybody aboard. The other sails along somehow, with dwindling resources and a few lifeboats. We in DevOps are snug and secure in the first ship. For those

in the other ship, the clock is ticking and the ship is taking on water. Those of us who care about the Big Picture understand that things need to change, that we need to come together rather than come apart. The question, how? This is the question I will leave to you to answer.

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TRUST AND SAFETY IN THE AGE OF AUTOMATION

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"As with any new technology, it's really important that we be thinking now about how to do [it] ethically and responsibly." — Robert High, Vice President and Chief Technology Officer, IBM Watson

Here's something to think about: According to an article in *The Wall Street Journal*, more than 30 countries have defensive weapons run by automation. South Korea has robotic sentries along the DMZ, while Israeli robots patrol the border at Gaza. Russia has robotic vehicles armed with 30mm cannons and anti-tank guided missiles that are well-equipped to battle it out with NATO forces should the need arise.

Got your attention? Wait, there's more.

The SeaHunter is a U.S. military vessel that can travel the high seas on its own for months without a crew to feed or protect. It's completely unmanned. And, it costs only $20 million per boat, less than half of the $49 million it costs to fire 59 Tomahawk missiles. At that price, the SeaHunter is practically throwaway.

The SeaHunter, an unmanned oceangoing vessel, can remain at sea for months at a time.

The implications are profound. The value proposition is hard to resist, Why spend billions on building and manning traditional warships when, for the same expense or less, you can have a navy of predominantly robotic ships patrolling the oceans of the world? And, you can have robotic aircraft, capable of automated takeoff and landing, using these ships as mobile bases. An air force untethered to any land mass is a game changer, particularly when non-state actors can get their hands on a few of them. It sort of brings new meaning to the word “pirate”—no need to board a vessel by force, just get the access credentials.

And, at the core of it all this modern weaponry is automation and growing capabilities in AI. That should give you something to think about.

We in DevOps are all about automation. It’s our raison d’être. Our fondness for, and dedication to, automation is admirable. We really have changed the way tech works. Yet, many of us think of our activities

as mundane. It's akin to the nonchalance of a Major League baseball player. They've hit the ball so much that many players have forgotten how skillful one needs to be just to foul off a bad pitch. Most people on the planet can't hit a Big League pitch, let alone make it go foul by intention. But for the pro, it's no big deal—it's just part of a day's work.

It's the same for us. We're so accustomed to automating our world that it's become no big deal. But, it is a big deal. *It's a very big deal.*

The easiest thing in the world is to trivialize the incredible impact our work has on others. After all, we're "just working on" an ecommerce site, a dating app, or IoT endpoint for wired bicycles, right? Those of us working in the defense industry might grasp the significance of the work, but for most of us, it's business as usual.

Here's the raw truth: Those of us doing the automation are changing the world. Each line of code we write is intelligence that alters the digital infrastructure of some part of the planet. The code we write will live on well after we're gone, whether it's from a company or from the planet. Are we really clear about the impact we have? Yes, some of our tech superstars are asking us to pay attention, but how many of us really are?

Every day that passes we give automation more power. It might be a little piece of power, such as letting only authorized users access to an application. It might be significant power, such as determining whether a person qualifies for a loan to buy a house. It might be enormous power, such as manipulating political forces toward a desired behavior. Or, it might be the ultimate power: Deciding who gets to live and who gets to die. But, regardless of degree, it is power and we have it. And, we continue to make automation more powerful. As surprising as it may sound, despite appearances otherwise, we're the ones the world trusts

intrinsically to do our work safely and responsibly. A lot of the world's safety depends on how we do our work. Political leaders don't write the code. We do.

Originally, I was going to call this piece "Death and Destruction in the Age of Automation" and write about how we've taken automation way beyond commercial IT into the realm of life-and-death decision-making. I decided otherwise. The world does not need another gloom-and-doom piece, nor does it need another piece of sensational journalism. We'd do better to focus more on the positive things we've achieved. Technology is doing a whole lot more good than bad.

But the fact remains that technology has accompanied death and destruction since Roman catapults assaulted the frontiers of ancient Europe. The thing that's really different now is that the technology thinks—or, at least, it's doing a really good job of emulating thinking. And, we're the ones making it think better. Thus, we should ask, Are we making technology think in ways that are safe and trustworthy? Are we acting in ways that are safe and trustworthy?

These are big questions. Do most of us really care about them? Or, is it easier to accept our work as mundane, with little consequence in the Big Picture? The nice thing about mundane is that it doesn't require a lot of ethical contemplation. But, when you consider that the script that deploys an updated container to a Kubernetes cluster is not that far from the one that deploys an unmanned warship to a regional hotspot, things look different. And, contemplating the implications thereof becomes more than an academic exercise in a computer science ethics class.

More than 2,000 years ago the philosopher Socrates said, "The unexamined life is not worth living." Given the immense role that

technology plays in today's world and the power it wields—power that continues to move further away from our direct control—we might do well to say, "The unexamined technology is not worth doing." It's something to think about, while we still can.

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THE 'BLOCKBUSTER EFFECT' IN THE AGE OF AUTOMATION

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Saying that new jobs will always be created to replace those that have been eliminated by automation is a mechanism for avoiding a real problem that's lurking on the horizon.

In 2004, at the height of its popularity, Blockbuster Video had more than 9,000 stores and employed more than 80,000 people worldwide. About 50,000 of the total workforce was employed in the United States. Going down to Blockbuster to pick up a movie was a Friday night ritual for many, this writer included.

Blockbuster and other video rental stores, along with the advent of affordable Big Screen TVs, were significant contributing factors in the growth of the home theater. People now had an alternative to $10 movie tickets and battling weekend traffic to get to the cineplex. An entire family could view a recent movie in the comfort of their own home for about $5. The only thing that was needed to complete the movie going experience was the popcorn, which frugal families bought at Costco by the caseload. Those who were less thrifty could buy a box of microwave popcorn at the checkout counter of the video store. The $25 cost of a Friday night date was reduced to roughly $6.

Blockbusters kept people on the couches and out of the movie theaters. Television had already put a damper on movie-going. In 1930, 65 percent of the population went to the movies once a week. By 1964, the number dropped to 10 percent. Despite the introduction of 3D projection technology and movie theaters offering added features such as in-seat dining, movie attendance is now at its lowest point since 1992.

Blockbuster was a transformational business on the entertainment landscape. Today, the company is gone. Streaming technology combined with an "all you can eat" subscription model killed it. (See Figure 1.)

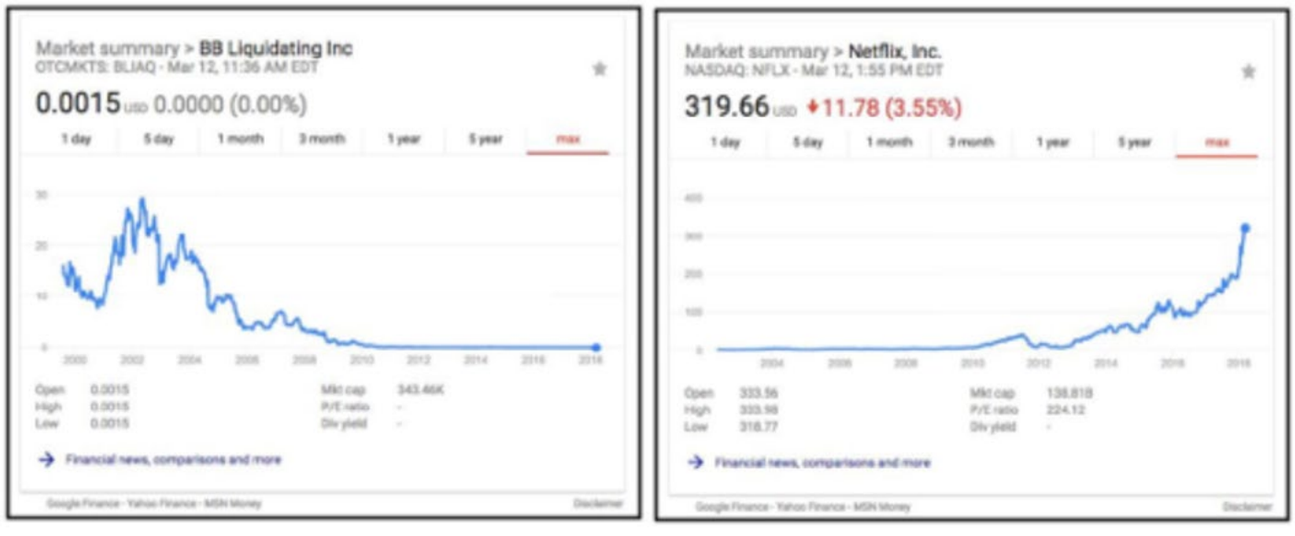

Figure 1: As Blockbuster stock declined, Netflix's grew.

Just as Blockbuster did away with the need to go to a movie house to see a film, Netflix, Amazon and other video streaming services did away with the need to leave the house to get the evening's entertainment. America stayed home and enjoyed movies on the internet for a fixed monthly fee. Blockbuster went out of business.

Netflix employs around 5,500 people with gross yearly sales of $11.69 billion. Blockbuster's gross sales in 2004 were $6 billlion. It's astounding that Netflix does almost twice as much business

as Blockbuster did at its height, with less than 10 percent of the Blockbuster workforce. Such is the benefit of automation.

Whereas Blockbuster needed to staff a store in every neighborhood to do business, Netflix and other streaming services work from a central, virtual location without the added expense of redundant staffing. Blockbuster had 9,000 cash registers to man. Netflix has one, which is run by some sort of AI.

So, where did all the out of work clerks and store managers go? Hopefully, they went on to other jobs, maybe ones that were far better than the day-in, day-out tasks that go with processing video cassette rentals. After all, that's the conventional wisdom: There will always be new jobs to take the place of the ones eliminated by automation. But, let's face a cruel truth: It takes a lot more knowledge and skill to work on video delivery at Netflix than it does to check out customer purchases at Blockbuster. And Netflix requires fewer people to make the business go. Would a Blockbuster employee in Sioux City, Iowa, have the skills and mobility necessary to go on to to work at Netflix in Los Gatos, California? Seems pretty far-fetched.

Right now, things are pretty rosy in terms of the economy. So the conventional wisdom prevails: As automation eliminates one job, another new type of job takes its place.

Yet, there is another way to look at it. There are good arguments to be made:

- As automation eliminates jobs in the modern world, new jobs for humans will NOT be created at levels required to keep a workforce fully employed. Rather, AI will do more and require less.

- The lead up to large-scale unemployment will not be slow. It will happen fast, over a period of a year or two. And, it very well might happen within a decade rather than decades in the future.

Blockbuster's demise came about pretty quickly. The company was at its peak in 2004. Six years later it filed for bankruptcy with $1 billion in debt. The music retailer Virgin Megastore closed its last North American store in 2009, a year after music streaming Spotify went public on the internet. (Spotify generated $3.8 billion in revenue in 2016 with an employee count of 2,162.)

Productivity due to automation continues to accelerate. In the early 1980s, it took 10.4 man-hours of labor to make a ton of steel. By 2014, the number was down to 1.9 man-hours per ton. The increase in productivity is due to increased levels of automation (think: robots). Given the choice between buying a machine and hiring a worker, companies are more likely to choose the machine. Thus, it's entirely possible to imagine that the day when a few humans will be supervising the work of many robots making steel is close. Not too soon after that, a single human will be supervising an entire robotic workforce. Then, finally, as AI continues to improve and further dominate the production landscape, no humans will be required. The robots will supervise themselves.

How far off in the future is this time? Dunno. But I can tell you that robots are now assisting with surgery on humans. How long will it be until one surgeon can use automation to do the work of 10? Then, how long will it be until AI can do surgery unsupervised, five years? Ten years? Only 10 years ago driverless cars were still on the test tracks; today they are roaming the streets of Mountain View, California. An autonomous robot with a scalpel is no longer the stuff of science

fiction. Once AI can do surgery unassisted, where will all the displaced surgeons find work? Maybe a few will go into research. What of the others?

At one time there were 200,000 horses in the City of New York. They provided the labor for a good part of the city's transportation system. Today there are fewer than 1,000 horses. Cars, trucks, planes and trains have taken over. There's no benefit to employing a horse when a car can do the work better. As General AI continues to develop and improve its ability to connect the dots as only a human can, how long will it be until the labor of most humans is not needed? What will it be like when there is no benefit to employing large parts of the human population because a machine can do the work better? Yes, the ramifications are scary. But, the possibility needs to be considered. The sad fact is that few people are considering such a scenario, let alone coming up with ways to address the impact on the horizon. Saying there will always be employment for humans is an avoidance mechanism, particularly given the fact that modern machines are going beyond purely mechanical labor and doing more thinking work.

In 1990, people thought there would always be movie rental until there wasn't. In 2000, people thought there would always be a Virgin Megastore until there wasn't. Today, Sears keeps closing stores. It will soon be gone from the face of the earth. Yes, Amazon is opening brick and mortar stores. This might be good news. But the fact that these stores are highly automated and have few employees cancels out the good feelings of the moment.

These days when a company comes to an end, it's not a drawn-out process. It happens fast, over a period of a year. Many of the people left behind are confronted with low-wage, "show up and do it" jobs. The more educated have access to a pool of better paying work that comes

with an excruciatingly steep learning curve. Whether the job is low-wage retail work or high-paying tech work, each worker is—or will be—competing against AI-powered automation that can—or will—do the job better.

It's not a pretty picture. But it is one that can avoided if we decide to think about alternatives and put those ideas into action. Sadly, there are more people thinking about how to get to Mars than solving the problem of unemployment on a massive scale due to the proliferation of industrial automation powered by general AI. The problem is that we still seem to be stuck at, "There will always be jobs to replace the ones eliminated by automation." To say otherwise is deemed Cassandra talk. Maybe so. But to not give the problem consideration is beyond folly. It's a danger that will exact a heavy price from everyone who has to work to earn a living.

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TESTING AND CERTIFICATION IN THE AGE OF AUTOMATION

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If we do not change the way we teach, 30 years from now we will be in trouble. Because the way we teach, the thing we teach our kids are the things from the past 200 years. It is knowledge based. And, we cannot teach out kids to compete with machines, they [machines] are smarter.

We have to teach something unique so that a machine can never catch up with us.

—Jack Ma, CEO Alibaba

TL;DR SYNOPSIS

Given the complexity of modern DevOps, technical certification is becoming more granular. Also, its use is exploding as a requirement for employment. Most technical certification is awarded by passing a test composed of multiple choice questions. Passing a test with multiple choice questions requires the test-taker to absorb a significant volume of knowledge for a short period of time. This acquired knowledge does not need to be retained. Hence, the certification can only attest

to the bearer's knowledge of a technology at the time the test was taken. And, essentially the test measures only the bearer's ability to take the certification examine. Finally, testing by multiple choice does not ensure the certification bearer's qualification in terms of required experience or higher-level thinking capabilities.

Technical certification is valuable in the current commercial landscape. However, at some point, as machine intelligence is able to perform more of the activities presently done by humans, the format and methods by which certification testing is administered will need to change. Future certification testing methods will need to put greater emphasis on analysis and creative problem-solving rather than the current focus on knowledge acquisition and rote application. Also, what and how we teach humans will need to be unique, beyond the capabilities of artificial intelligence.

Over the last 10 years, DevOps has become a much more complicated landscape. Regardless of the service provider of choice—Amazon Web Service, Microsoft Azure, Google Cloud, OpenStack, IBM, Joe's Homegrown Cloud Service—you gotta know a lot to play.

At a high level, service providers offer products that are surprisingly similar. For example, they all provide some sort of machine virtualization, storage services, database services, queuing technology, authorization service, provisioning technology and API management. But the way you manipulate the conceptual knobs and switches to get any of these products to work can vary dramatically between providers. There's a lot of minutiae involved. Absorbing the amount of detail required to be productive in a provider's product line takes time. And, ensuring that someone can actually work competently with a service provider's products is a crapshoot. For example, a deployment engineer may understand the concepts behind dynamic provisioning,

but getting a Kubernetes orchestration to work in Google Cloud is where the rubber meets the road. Doing is always much more difficult. As I said, there's a lot of detail involved.

So, how do companies ensure that the people they hire to fiddle with their multimillion dollar, mission-critical technology stack will deliver the goods without blowing things up? Most have an extensive technical interview process accompanied by a stringent reference check. Some just hope. Others require certification.

THE RISE OF MICRO CERTIFICATION

The notion of certifying that a person has the skills and experience required to be competent in a profession has been around since 1885, if not before. That was the year Massachusetts implemented the first written bar exam. Before that time, all a person needed to do lawyering was to get a note from a court saying the person could be a lawyer. That's how it went for Abe Lincoln. Eventually the profession matured. Professional qualification was determined through a test-based approach. Early bar exams used essay questions. In 1972, with the addition of the Multistate Bar Exam, multiple choice questions were included.

Going to multiple choice questions may seem like a trivial change, but it's not. Whereas a knowledgeable professional is required to grade an essay question, multiple choice answers can be evaluated by anybody with the answer key. Hence, the popularity of multiple choice questions on the SAT. It's the most efficient way to grade millions of high school test-takers each year. Evaluation is fast, cheap and a machine can do it.

As I mentioned at the beginning of this piece, IT in general and DevOps in particular has become a place of increasingly granular complexity. There are a lot of technologies on the landscape. Each of

those technologies has a significant learning curve to be overcome to achieve mastery. The conventional wisdom is that the best way to determine mastery is to test a person's knowledge of the given technology and then measure the results of the test—high score, good; low score, bad. As with early testing practices, the fastest, cheapest way to make an evaluation is to administer a test made up of questions with multiple choice answers. This is sort of like the SATs, except most technical certification is geared to a particular vendor's product line, not a general body of knowledge. (You can view a sample of test for AWS Certification as a DevOps Engineer Professional here).

This type of professional testing paradigm is exploding. It's infiltrating every corner of the technology landscape. And, more employers are requiring certification as conditions of employment, both for prospective employees and those already on staff. This would be OK, except for one thing: After you scrape away all the preconceptions and assumptions about the value of test-based certification, when it comes down to the bare-bones validity of test measurement, the only thing a test really measures is the ability to take the test. For example, a deployment engineer might be sitting for a certification test after having been up all night working to get the company back online after a system failure. The taker, who is exhausted, ends up failing miserably. Yet, some slacker just out of high school who has never seen in inside of a data center can take the test using stolen answers and pass with flying colors. Tell me, please: Who is really the most qualified professional?

TESTING BY REGURGITATION

Certification is not the problem. After all, I really do feel more comfortable knowing that the surgeon about to open up my wrist to alleviate my carpal tunnel syndrome is certified by the American Board of Surgery. Rather, the problem is the way that certification testing is conducted. In my opinion, a certification testing process

that emphasizes the multiple choice question-and-answer format is flawed. Even when questions are answered correctly, the test format does not really verify the competence of the taker, only that some facts are known. It's just testing by regurgitation.

Such testing requires the taker to absorb a lot of knowledge and then dump it out according to the test requirement at hand. There is no guarantee of long-term retention. It's the age-old process of cramming for the test. Once the "time's up!" bell rings, the chances are that the test taker will forget most of what she absorbed. Those with photographic memories might remember it all, but for most of us mere mortals, it's a one-shot deal.

Few people in tech work using the cram-it-in method. Most of us just use this thing called the internet to get the answers we need, when we need them. It's what Bill Gates calls "information at your fingertips." Yet, we still test for the knowledge in your head at the moment.

There is a better way.

A BETTER WAY

Certification is good provided it ensures that the bearer knows what he or she is doing. When certification is about nothing more than checking the right checkbox on an online test, there's a problem. Put a monkey in front of a multiple choice test for eternity and eventually the animal will score 100 percent.

So what do we do? We do the following:

SUPPORT OPEN BOOK TESTING

If the purpose of the test is to ensure that a person has a certain body of knowledge at the time he or she takes the test, make the body of knowledge required available at test time. It's called open book

testing. That's how it works in real life. For example, you need a NodeJS package to provide mock objects. Do you rely upon your existing knowledge about the packages you know? Great, but what if you don't know? Does work come to a grinding halt? No. You go to NPM to find one that meets your need. That's how it is in real life. A competent professional is expected to have a baseline, high-level knowledge of his or her professional domain. For the day-to-day details, a pro has the ability to find accurate answers to questions quickly.

Instead of having a certification testing process based on cramming, maybe we should eat the dog food we make in real life and go open book. There is little downside to researching what you need, when you need it. Besides, the test question created a week ago might be best answered by a new technology created today.

PUT THE EMPHASIS ON ESSAY QUESTIONS

The actual mechanics of testing vary according to the level of cognition being examined. I wrote an article about this a few years back. The best way to test higher-order thinking—analysis, synthesis, evaluation—is by using essay questions. After all, what is a Ph.D. dissertation if not a very big essay question? Essays require a level of thinking that is hard to capture using lower-order test methods such as multiple choice. Essays reveal not only what the test taker thinks, but also how the test taker thinks. There's a reason why your high school math teacher wanted you to show your work when taking an algebra test. Sometimes how you get the answer is just as valuable as the answer itself.

A good certification test will provide a question format that allows test takers to illustrate their thinking along with the way they arrived at an answer. Thus, the need for a bias toward essay questions. Again, how you think is just as important as what you think.

PUT A HUMAN BACK IN THE EXAMINATION PROCESS

I'll share an intimacy with you: I'm not very good at answering multiple choice questions. When confronted with one, I spend a lot of time trying to figure out what the question is really asking. You'd be surprised at the number of test questions out there that are vague and confusing.

This was a real problem for me back when it was time to go to college and do the SAT dance. Fortunately, my alma mater focused more on my essays than my SAT score. Also, a lot the exams during my collegiate years were administered as essays or conducted as interviews with a professor. Later, when it was my time to be the Guy Awarding the Grade, my process was to evaluate students by interviewing them about one or many of the projects they did. I based my grade on the quality of the project itself and the thinking that went into the work. I tested my students by talking to them and reviewing their work. I like to think that I got a pretty accurate idea of a person's competence, more than a multiple choice test could ever provide.

Providing the opportunity for human interaction in the examination process can go a long way to providing the information required for making an accurate evaluation of a person's competence.

REQUIRE TESTIMONY OF A CANDIDATE'S EXPERIENCE, CHARACTER AND COMPETENCE

Think about this: It's possible to be an AWS Certified Solutions Architect Professional without ever having done a day's worth of paid, real-world work. All you need to have done is pass the certification exam. Yes, of course passing the exam is meaningful. It's a grueling test. At the least, the test might prove that should be able to work the conceptual dials and switches that go with a given AWS service. But, as far as having the real-world experience, competence and character

to play a critical path role in a mission-critical enterprise, some other instrument of certification is required. This instrument is sometimes called a reference—or, as the Wizard said to the Tin Man in *The Wizard of Oz*, a testimonial.

As you read above, back in Abe Lincoln's day, a letter from a court attesting the good moral character of the bearer was all that was required to practice law. You can think of good moral character as the ability to show up on time, do reliable work, demonstrate a commitment to excellence and get along with others. Such a description might sound melodramatic, but it counts.

While it's true that some certifications require that bearer to have a modern version of "good moral character," in addition to good test scores, many do not, particularly in tech. An employer wants to hire people who know what they're doing and have the wherewithal to work effectively in an organization. Potential candidates want to provide evidence that they have what it takes to be a good employee. Building a testimonial of the bearer's experience, character and competence into a technical certification will add a great deal of value for all involved. Also, the testimonial needs to affirm the bearer's ability to adapt to change. In the not too distant future, your commercial value will not be about what you know today, but rather how fast you can work with technologies that will appear tomorrow.

HOW TO WIN THE RACE

For better or worse, we're in a race with machines to keep our jobs. They don't really want our job. They're incapable of desire. But, that's not to say they can't have our job should the machine prove to be able to do it. Sadly, the current practice of technical certification is focused on passing tests concerned with the acquisition of knowledge.

Right now, we're winning the race. Machines still have problems

with knowledge-based tasks involving advanced image recognition and reading comprehension. We still know how to differentiate between a dog, cat and an apple tree better than a machine can.

But, it's not always going to be this way. Keep in mind that talking machines were very primitive 20 years ago. Their voice had an artificial, staccato rhythm that was distinctly robotic. Today, it's hard to tell the difference between a human or machine when a robocall disturbs your evening meal. It's only a matter of time before the machine can do mid- to high-level knowledge-based work better than any human. Jack Ma's quote at the beginning of this article supports this assertion.

We need to change. The commercial value we'll bring to the workplace in the future will be about analyzing, synthesizing and evaluating. Machines will be able to to the lower-level thinking faster and more accurately than we ever can. The realm of human excellence will be about better understanding the world around us and bringing new things into that world. The way we start is by teaching something so unique that the machines can never catch up. This thing is creativity. The paradox is that creativity can always be learned, but rarely be taught. Still, we must try. We have little choice not to.

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THE CASE AGAINST HUMAN EMPLOYMENT IN THE AGE OF AUTOMATION

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A few months back, the small Japanese restaurant down the street from me was renovated. The owner redesigned the layout of his business to solve a vexing problem: How to stay in business when faced with a continuing pattern of employees not showing up for work.

The layout of his restaurant went from this:

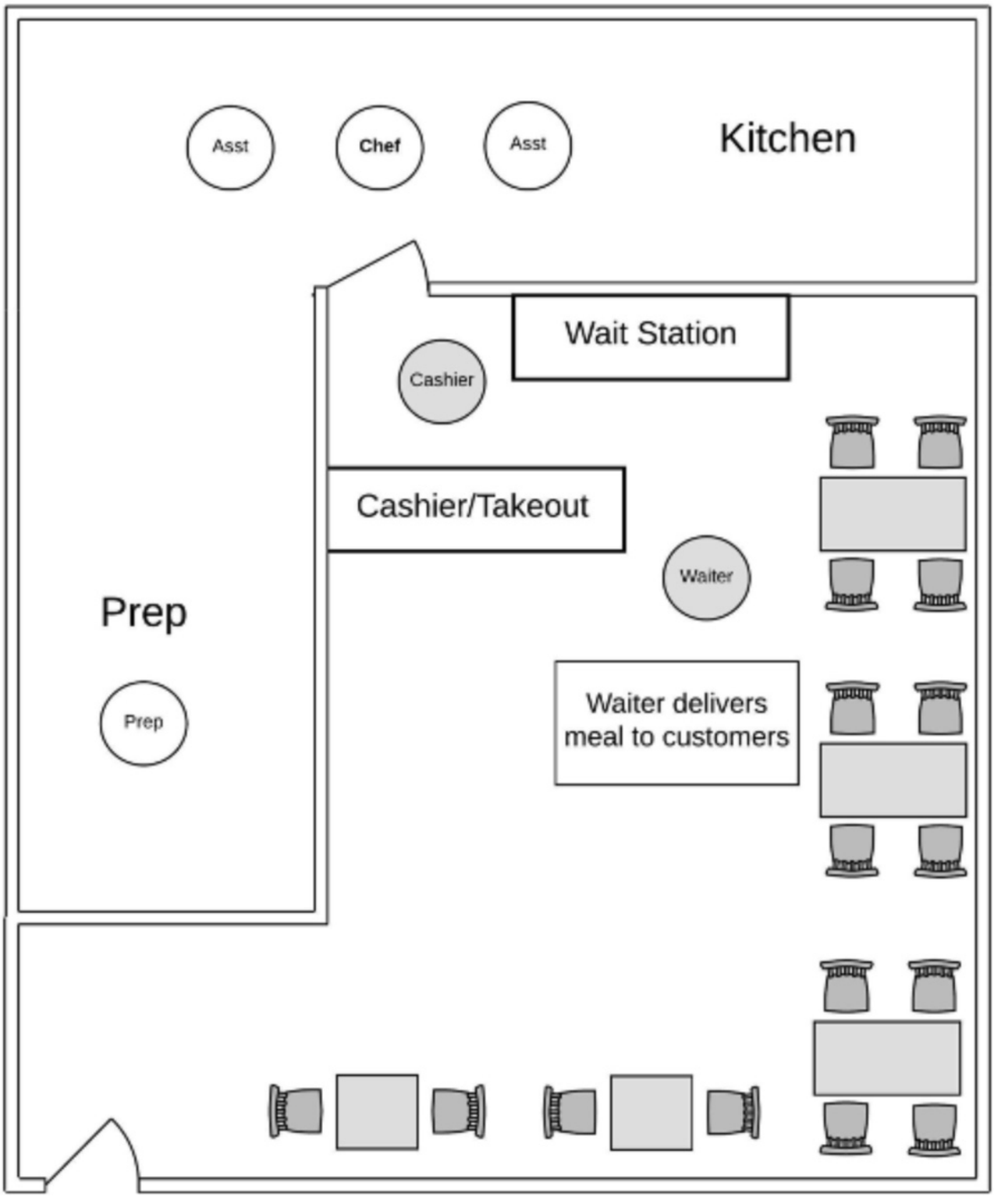

Figure 1: The pre-automated local Japanese restaurant

To this one:

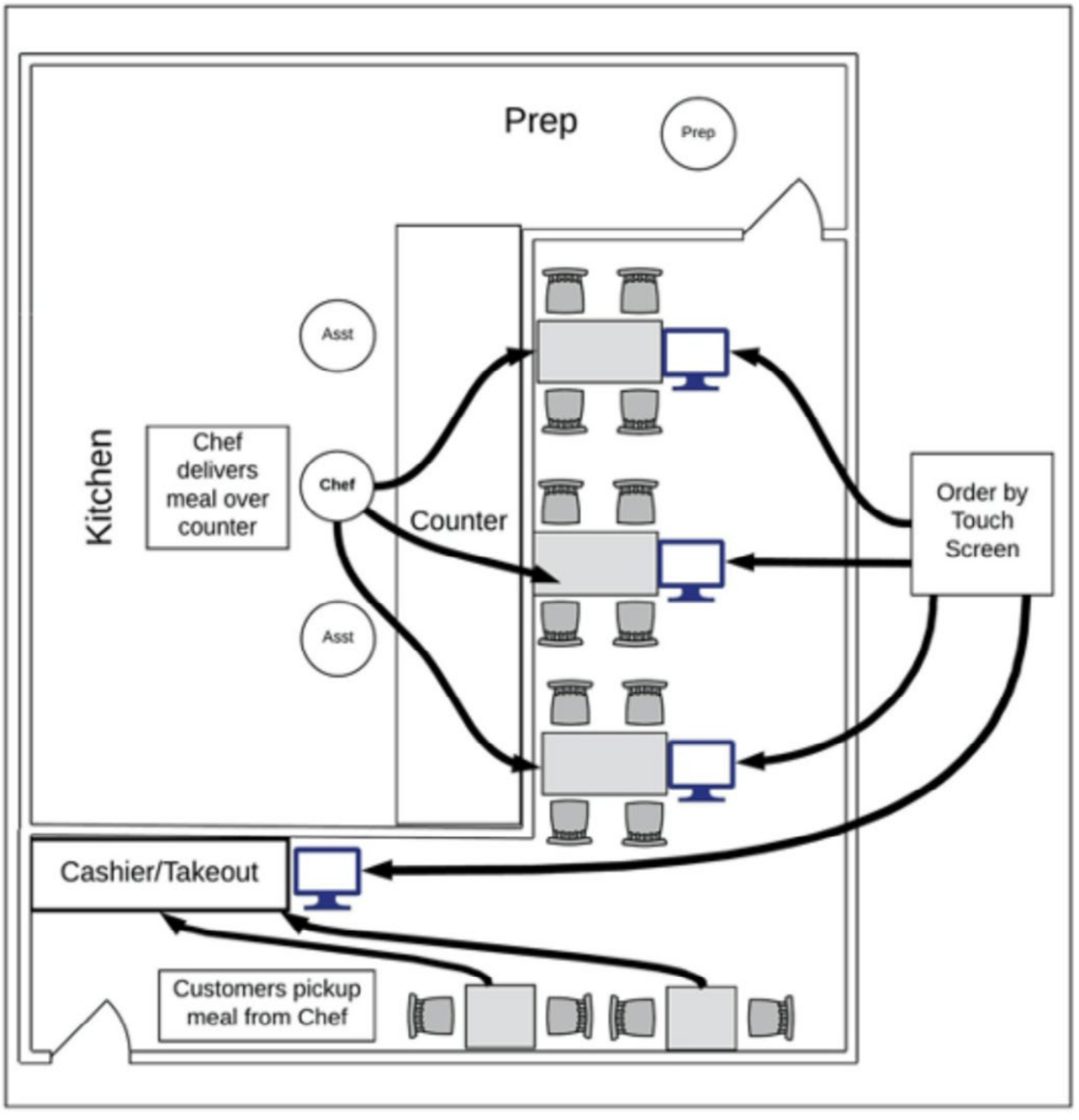

Figure 2: The neighborhood Japanese restaurant after automation

The new layout eliminates the need for servers. It turns out, the people he hired to take orders and bring food from the kitchen to a customer's table just weren't showing up for work. We're not talking one or two random no-shows; rather, it was habitual behavior among the workforce he hired, mostly high school grads and college students. Each day was turning into a crapshoot. He'd get a text an hour or two before the beginning of a shift reporting some other excuse: sickness, lost dog, whatever. Usually, the note closed with the inevitable, "Sorry,

won't be in today. See you tomorrow."

So he automated.

The new design is working out well. You come in. He directs you to a table. There's a touch-screen monitor at each table diners use to place their order. The orders go directly to the kitchen, which is separated from a row of tables by a glass partition. When a dish is ready, the owner (who also happens to be the chef) or an assistant passes the food out to the diner's table under an opening at the bottom of the glass (see Figure 2, above). At the end of the meal, the owner meets you at the front station where you pay the bill. No more wait staff. No more cashiers. No more "I can't make it today" texts.

AUTOMATING TO STAY IN BUSINESS

Removing the servers and using automation was not an easy decision for the owner. His business is not some large-scale, multi-unit corporate enterprise looking to automate away human labor to increase profit margins. This guy has worked seven days a week for 10 years to build his business into a mainstay of the neighborhood. He prefers to employ humans but he can't. He's automating because the available human labor is unreliable. He believed that using such an unreliable workforce would eventually put him out of business. He really needed to make the change.

So he did.

NO EMPLOYEES, NO EMPLOYEE RETENTION

So far, things are going well. However, now the kitchen staff is beginning to join the No Show Club, despite the fact that he is hiring kitchen workers at a rate of $14 an hour—a good wage for kitchen work. What's causing people to go MIA? Maybe it's the product. After all, how many California rolls can you make before going nuts out of

boredom? Maybe he's difficult to work for. And I doubt they're jumping ship to work at Mickey D's; the Golden Arches is only paying $10 an hour. In any event, the owner has a employee retention problem that, my guess is, he's going to solve using automation.

WHAT DOES THIS HAVE TO DO WITH DEVOPS?

At some point, every human being becomes unreliable. Some have poor work habits, but most simply are being human and humans make mistakes. That's how we're built. Some of us make a few mistakes, while others make a lot. But, we all make mistakes. Most of us learn from our mistakes, and we still make others. Our human nature to make mistakes makes us inherently unreliable.

Machine intelligence doesn't have this problem. It will get things right, eventually. And then, once operating reliably, it's rare for that intelligence to revert to a state of unreliability. A human can become unreliable at any point in time—taking a sick day, resigning from the job or all the mistake-making that comes with learning a new skill or technology.

We in DevOps have a lot in common with the owner of my neighborhood Japanese restaurant. Most of us have worked really hard to keep our customers happy and coming back, well beyond the typical 40-hour work week. For the most part, we've been successful.

Our success increases demand. When demand goes up, the complexity of our work increases, as does the need for more reliable operations. But at some point, our inherent human unreliability kicks in. We make mistakes. To keep things going reliably, we automate. Then we move on to the next thing. Fortunately, for the foreseeable future, there will be a "next thing" to move on to.

Still, intrinsic to our work is a motivation to eliminate human labor

from the technical landscape. We have no evil intention. We just want to do the best job possible. Given the choice between a script and a human doing the work, we're going to choose the script every time. The script will evolve to 100 percent reliability. The human won't.

As I said, for now, it's not really a problem. There will be a next thing to move on to. And, in terms of my neighborhood sushi joint, maybe the out of work no-shows will get the message about the value of showing up at a job on time and ready to work. Or, maybe they won't. Maybe as automation becomes the standard of labor fulfillment for repetitive work, immature workers will never be given the opportunity to get the experience they need to enable them to master basic employment skills. After all, they're human and some point will become unreliable. So why hire them at all? Why not get a few computerized gizmos to do the redundant work and then focus on keeping customers satisfied and staying ahead of the competition?

Having no employees translates into having no unreliable employees. A business without unreliable employees is an efficient business. Efficiency in business is what it's all about.

And this, my friends, is the case against human employment in the age of automation.

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WHEN IS BIG AUTOMATION TOO BIG FOR COMFORT?

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There's a joke traveling around the tech-o-sphere that goes like this:

How many software developers does it take to change a lightbulb?

Answer: None, it's a hardware problem.

In the world of modern DevOps, physical infrastructure has been abstracted to code. I can count on my fingers the number of people I know who have done a physical memory upgrade in the last year. Fortunately or unfortunately, depending on your outlook, I am one of them. Nonetheless, for the most part, hardware left the building a long time ago, no pun intended. All that remains is the laptop we use to move the bits around.

However, for those who don't sling code, the world of automation is much bigger than our software-centric view. Most of us are aware that today there is hardware that can roam around our living room unassisted and vacuum up dirt from the floor. There's 3-D printing, which is a technology my dentist uses extensively to fabricate crowns in the privacy of a closet next to an examination room in his office.

And of course, the driverless car and truck is predicted to soon be a regular part of our day-to-day landscape.

But, this is the small stuff. There's a lot of hardware automation that goes well beyond the dimensions of consumer appliances and room-size automation technologies being used in factories. In fact, machine automation is becoming gigantic, as in Godzilla-size, particularly in mining.

MINING: LET'S EAT A MOUNTAIN

Equipment has been essential to mining since the first days when a man was sent into a cave with a pick and shovel to extract ore. Mining has come a long way since then—today, it's a gargantuan undertaking that has become more incredibly machine-intensive. Whereas, in the past, we'd send men into a shaft in the ground to get the goods, these days, we just let a machine eat the ground, literally.

The Bagger 293, shown below, is a bucket-wheel excavator. The 315-foot-high machine can dig a 8.5 million cubic feet of earth per day.

To give you a sense of how big this whole operation is, first understand that, 315 feet, the height of the machine, is approximately the equivalent of the height of the Statue of Liberty, from ground to torch top. The amount of dirt that the machine can remove in a day is equivalent to digging an eight-level sub-basement beneath the floor of the Roman Colosseum. The Bagger has been in use since 1995, and no matter how you cut it (again no pun intended), that piece of iron has eaten a lot of dirt.

The Bagger 293, with a height of 315 ft, is taller than the Statue of Liberty

Presently, the Bagger requires a crew of six to operate. But, if trends keep steady, it's only a matter of time until machine excavators of this size can operate autonomously.

Sound far fetched? It's not, really. The Komatsu AHS already has a mind of its own.

The Komatsu AHS is an autonomous earth-moving vehicle that can move a payload of 290 tons. The machine is the size of an average house.

In the past, it would have taken a small army of men weeks, if not months, to mine raw materials. Today, using technologies such as the Bagger 293 and the Komatsu AHS, the work can be done with a workforce of six. And, in the not-too-distant future, the work will require no human intervention whatsoever.

So we'll have machines that can get massive amounts of dirt out of the ground and move it around without the need for any human intervention, But, once mined, where does it all go?

The Komatsu AHS (right) is an autonomous earth moving machine

Hold that thought. The answer is coming.

THERE'S MORE TO CONTAINER AUTOMATION THAN KUBERNETES

Yara, a shipping company out of Oslo, Norway, in partnership with Kongsberg, a maritime engineering group also out of Norway, has created an autonomous container ship, the Yara Birkeland, that is set to hit the high seas in 2018. This ocean-going vessel will be manned by a crew of none. It's completely driverless.

According to the Bureau of Transportation Statistics, more than 19,000 vessels entering U.S. ports in 2010 were container ships. That's 31 percent of total maritime activity on American docks that might very well see the elimination of seafaring crews.

Container shipping is useful because it allows for the easy transport of goods from a variety of shippers. In the past, dockside longshoremen loaded individual bails, crates and barrels into the hold of ships by hand using winches, conveyors and stackers. Container shipping made it so the shipper loads a container and then a machine loads the container onto the ship like stacking Legos. One human does the work of dozens.

The Yara Birkeland, to be completed in 2018, is a zero-emission, autonomous container ship that is estimated to remove up to 40,000 truck journeys.

Mining transport does not have the burden of having to accommodate a variety of goods in different sizes and shapes. There is only one product: raw ore. Thus, it's quite conceivable that an autonomous container ship, maybe one the size of four soccer fields, can be repurposed as a giant, seagoing container holding nothing but a single product: unprocessed ore.

So, let's look at the dynamics of the supply chain overall. In the not-too-distant future, a machine will roll up to a mountain. It will start to eat the mountain, spitting out dirt one gigantic mouthful at

a time into the bed of an equally gigantic, autonomous dump truck. And that dump truck will unload its contents into the hold of an autonomous, seaworthy vessel that very well might take the contents to an automated mineral refinery for processing.

Those of us who have had to change a lightbulb recently understand the implications. They're profound. Those of us still trying to figure out how to program our smart home to do the light bulb-changing might need a bit longer to catch on. But, the notion remains: If we can create a machine the size of a building to act on its own, how long will it be until we are creating building-size data centers that can act on their own? Automation on such a gigantic scale is not only possible, it's inevitable. Controlling an out-of-control home vacuum is one thing. But, what happens when something on the order of a Bagger 293 goes beserk?

I don't know. But I can guarantee you that it will not be business as usual. The good news is that the Bagger only moves at about a mile and a half a day. But still, if it learns how to speed up, then might we one day wake up to find our favorite hiking hill gone due to the whims of an independent intelligence that cares not or knows not of our love of nature? What then?

As they say in the terrain, forewarned is forearmed.

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AUTOMATION AND ITS IMPACT ON CULTURES

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Let me tell you about my granddaughter. She's 14 years old and wicked smart. For a while we did pair programming together online in Python. In the old days you took your grandkids fishing. Today we code. Go figure.

These days, we don't program together as much. She's too busy preparing for math competitions. As I said, she's wicked smart. Needless to say, my granddaughter has quite the future in front of her.

A few weeks ago, I had the opportunity to visit her in real time and space. We sat around drinking hot chocolate and cappuccino, talking about Big Picture stuff. That's what grandparents are supposed to do with their grandkids, talk about matters beyond the day to day. At one point during the conversation I asked her the following question, "Are you friends with anybody who has trouble reading?"

Her reply was, no. All her friends read quite well and were interested in things that interested her. She wasn't bragging or anything like that. It was just a matter of fact. All her friends are smart, engaged, have cell phones and know how to work a computer.

My question came from a book I had just finished reading, "Coming

Apart," by Charles Murray. One of the key points that Murray makes is that we're dividing into two cultures and the distance between the two is growing wider. A key way to figure out how far from that "other" culture you are is to tally up the number of friends you have who have trouble reading. One camp will have a lot. The other will have practically none.

Back when I was my granddaughter's age I had friends who had trouble reading. We met playing pickup basketball. The ability to read wasn't important in that context. We based friendship on other factors. We played ball and rubbed off on each other. Some of the things that the poor readers were good at rubbed off on me. I like to think some of my better qualities rubbed off on them.

But that was then and this is now.

In the book, "Brave New World," written in 1932, people are born in test tubes according to genetic recipes. Some grow to be highly intelligent, creative, analytic Alphas. Others grow up to be be Betas, people that can perform highly complex tasks such as mixing volatile chemicals, but without having an inkling of understanding as to why they are doing the task. Gammas were good at adding up numbers and thus, become bookkeepers. Deltas are the truck drivers and elevator operators. Epsilons are grown to be three feet tall and abhor the outdoors. They do the dregs of factory work, climbing in and under machines.

Now, hold that thought while I tell you about my daughter.

My daughter is a high school teacher. Most of her students are from what is termed, the wrong side of the tracks. They don't read that well and are not terribly engaged in school. But, they do have cell phones

and they know how to use them—mostly to text back and forth to home and with friends in classes in other parts of the building. To use the transportation analogy, for all intents and purposes they use of technology not so much to explore but to get from one place to another, something a driverless vehicle will do better than the human counterpart in the not-too-distant future.

So, what does this have to do with DevOps?

We in DevOps are the people who are going to drive most, if not all, the technology that will control the world. We are the Alphas. To get into our club you need to be very, very smart. Our work is complex and requires both commitment and ability to engage in continuous learning. When my granddaughter comes of age, she will mostly likely get into the club, maybe with honors. She lives in a world of increasing returns. Because she is smart, she hangs out with smart people. Because she hangs out with smart people, she will get smarter. To use an analogy: Those who know how to work GitHub have a universe of code at their disposal. Thus, they will make a lot more code for the world to use. Those who can't do a pull request are stuck dead in their tracks. Access to opportunity provides more access to opportunity.

Using the model in "Brave New World," those using GitHub creatively as part of the software development life cycle can be considered Alphas. Those who can't are Betas, Gammas, Deltas and Epsilons. The really bad news is that the work of Betas, Gammas, Delta and Epsilons is low-hanging fruit for replacement by automation and robotics. The work of Alphas is a lot more difficult to emulate with machine intelligence. Corporate employers will still need them. The Alphas will do just fine.

Hopefully, those who are displaced by automation will be assuaged

by low-cost television and cell phone plans that offer unlimited data and texting. Otherwise, they're going to be looking around for something else to do instead of working. Hopefully there will be "something else to do" while the other culture is prospering.

My granddaughter's world reflects the trend that Murray and others describe. We're dividing into two cultures and the distance between these cultures is growing. The sad part is that the experiences that used to provide a bridge between cultures are becoming less common. There are fewer common spaces in which we can rub off on each other benignly, with no other agenda than to get the ball through the hoop. If the trend continues, the cultures will grow so far apart that they will become unrecognizable to each other. Once recognition leaves the landscape, understanding and empathy are not far behind. You cannot have affinity for that which you cannot see.

Is it possible to reverse the trend? Is it possible to have an outcome other than the very probable one on the horizon? I don't know. But, if we don't try, the ramifications will be dire.

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AUTOMATION: ADDRESSING BOT SECURITY WITH BOTCHAIN

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Bot technology is all the rage these days, and with good reason. Bots help you shop and provide customer service. In fact, one bot keeps contacting me on Facebook, telling me how I can optimize my marketing spend. They're everywhere and they're getting smarter all the time. Any one bot can access the entire intelligence of the internet to answer your most arcane questions or give you insightful suggests tailored to the details based on your online profile.

Still, the full potential of bot technology has yet to be realized. Right now, most bot interactions take place between a bot and a human. But, what would it be like if bots could bring their powers of recognition, recommendation and bargaining to bear interacting with other bots? Such a time is not that far away. The implications will be profound, particularly for those in DevOps.

THE EMERGENCE OF BOT-TO-BOT COMMUNICATION

Machine-to-machine communication is nothing new. Unassisted

stock trading has been going on for years. A machine monitors stock exchanges throughout the world looking to buy or sell stock according to its programmed logic. Once an opportunity is identified, a trade takes place without any human intervention. While it is true that each machine is acting with some degree of autonomy, the scope of interaction is limited. A machine designed to buy and sell stock is not going to go awry and buy a car. Also, the details of the interaction are well-known. When a trade takes place, the details of the transaction are recorded and an audit trail is created on both ends of the transaction. However, when it comes to bot technology, things start to look different.

Bots can act autonomously. For example, imagine a bot that is on a mission to find the best price for red sneakers in size 9. Instead of using a predefined list of sneaker vendors, the bot can use an internet search service such as Google to find online merchants that sell sneakers. The bot will use the result of the search to continue forward, looking for the best sneaker price. (See Figure 1.) As you can see, there is a good deal of machine autonomy in play already.

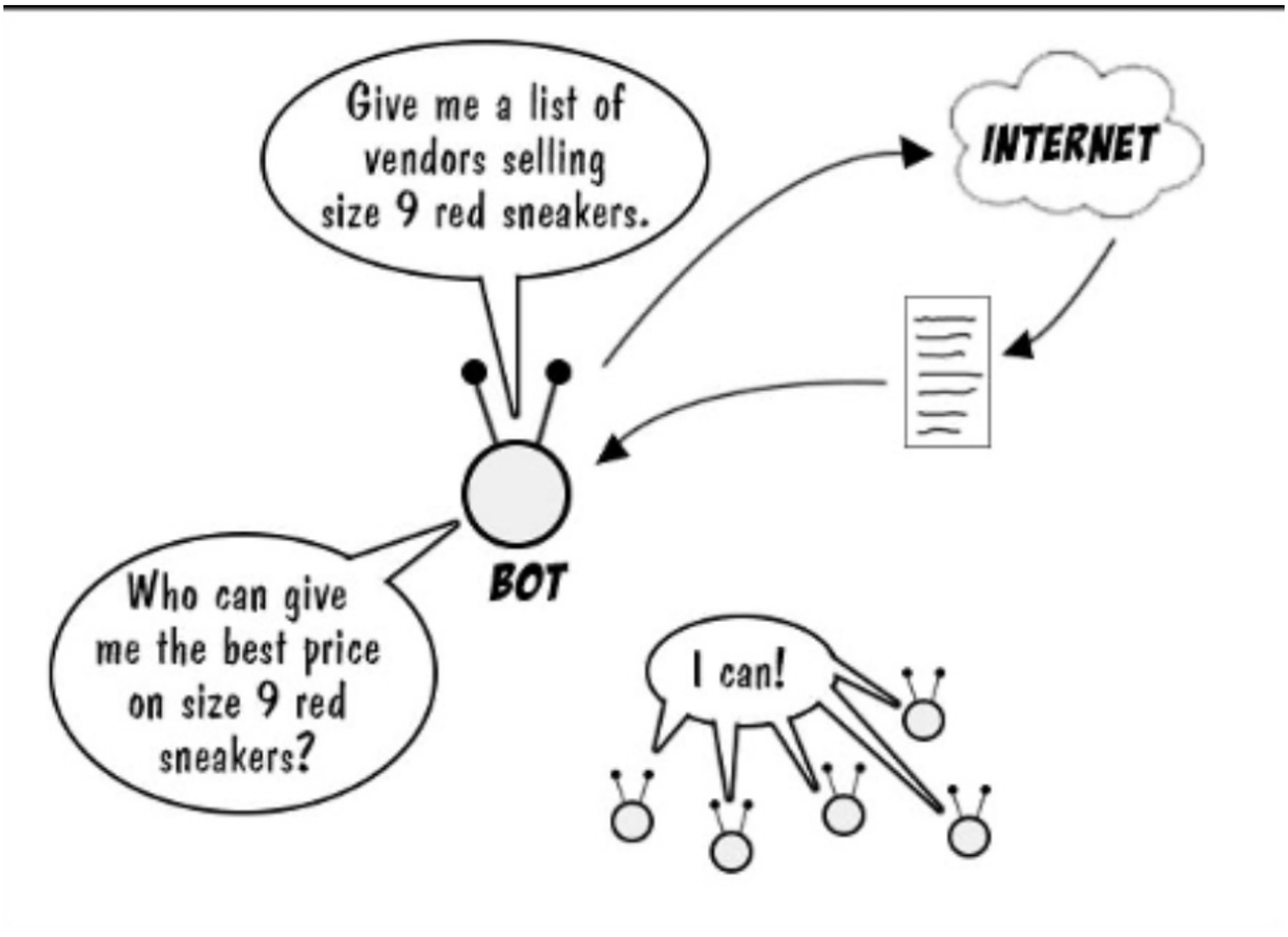

Figure 1: Bots use the internet and can act autonomously

Once the best price for red sneakers in size 9 is identified, typically, the bot will defer back to a human to make a purchase decision. However, deferring to a human is not mandatory. As we saw with the stock trading scenario, a machine-to-machine purchase transaction is entirely possible. Thus, given the proper programming, there is nothing to prevent a "buyer bot" from interacting with a "seller bot." Furthermore, it also is entirely possible for the "buyer bot" to interact with a variety of "bank bots" to determine the best credit card to use to make the sneaker purchase. Who knows? Credit card "A" might be offering better air miles than Credit card "B" on that purchase date.

The important thing to understand is that, in the past, machine-to-machine interaction was pretty much a two-party interaction that is well-known. Today, modern bot technology makes it possible for a bot to engage in any number of transactions with any number of other bots

with a high degree of autonomy. Along with such autonomy comes a good deal of risk: Any one of those bots could be an impersonator or could be using fraudulent information.

THE PERILS OF BOT IMPERSONATION

Any transaction is subject to fraud—a person writes a check without the backing funds, another makes a purchase using a stolen credit card, somebody else submits an invoice to a company by impersonating a vendor. These types of misdeeds happen all the time within the scope of human activity. So, too, will such crimes happen with bots. Just as a cybercriminal can impersonate a bank website to lure unsuspecting customers into giving away money and sensitive information, bots will be able to fool other bots into fraudulent transactions.

As bots become increasingly autonomous, the degree of harm that one bot can perpetrate upon another will grow, too. So, what's to be done?

ENSURING BOT-TO-BOT INTERACTION USING BLOCKCHAIN

If you want to know that bots are playing by the rules, you have to be able to observe their behavior. For those in DevOps, the usual way to observe the behavior of the systems within an enterprise is by analyzing logs.

Logging is a way of life in DevOps. We put logging statements into the software we write to report the details of the commands executed; we put entry dates in the records we write to our databases; we log the requests being made to websites, and administrators use logs to provide the audit trail necessary to determine the integrity of the transaction being made in systems and between systems. Coupling logging with comprehensive system security and data encryption practices makes it so that IT operations knows who is in the systems and what those entities are doing.

However, given the autonomy that bots can have and the wide scope of interactions that they can engage in, the usual mechanisms used to determine transactional integrity degrade. Going back to our red sneaker example described above, imagine the "buyer bot" contacts an unknown number of "seller bots" to negotiate the best price for a sneaker. Part of the negotiation process is in a bidding war among all the "seller bots." Then imagine that once the sneakers have been identified, the "buyer bot" negotiates with two "bank bots" to determine the best credit card to use. That's a lot of transactional activity, all of which is dynamic and most of which is unknown. How do we know that each of those "seller bots" is authentic? What do we know about the details of the negotiations done by all the bots in the bidding war for the sneakers? How do we know that the credit card used to make the purchase is not stolen? The fact is, without a common source of truth that describes all the transactions in the sneaker scenario, we don't.

While it is true that each bot might keep records of its part in a given conversation or transaction, there is no common ledger that records all interactions made by all the bots in the given scenario. Without a common ledger by which to audit the activity, the security, integrity and quality of bot behavior is compromised.

This is not a new problem. Those who work with cryptocurrencies have had this problem for a long time—making sure that the information provided in a transaction is authentic, true and auditable. The way that cryptocurrency systems solve this problem is to use blockchain technology. Given that cryptocurrencies and bots share many of the same security issues, blockchain technology can be applied to bots. In fact, there is an emerging technology that applies the principles of the blockchain to bots. It's called botchain.

Botchain makes it so that all activities conducted among bots are

reported in a common, secure ledger. The botchain ledger is a distributed resource on the internet. Botchain provides the mechanisms and audit trail required to ensure that bot-based transactions on the internet are conducted by authentic bots, acting within the scope of their rights.

Botchain technology is projected to be an important part of the modern internet, particularly as IoT technology grows. As bots become more a part of general DevOps landscape—particularly in the e-commerce-enabled IoT space (think: refrigerators that can buy their own inventory)—systems and engineering staff will need to become more adept at using botchain technology to protect the enterprise.

Bots will bring added benefit to the enterprise, no doubt, but they will also create new types of threat vectors. Agent impersonation is but one one of many security risks that are sure to emerge. The wise DevOps organization will do well to prepare. At the least, having a working knowledge of botchain will be a good insurance policy to battle the threats on the horizon. As those of us in IT have learned, the best insurance you can buy is the insurance you never use.

Mastering the details of botchain technology is an excellent way for DevOps to address the security issues that will arise with the increased use of bots in the modern internet. There is little downside in preparing for a future that is sure to come.

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AUTOMATION: WHERE DID MY MIND GO? OR, NO NEED TO REMEMBER

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Allow me to share a secret: My handwriting is atrocious. If it were not for the keyboard upon which my fingers are tapping and the laptop that is processing the result of my taps, this article would not be happening.

I've always had poor handwriting. But, it's gotten worse over time. Other than the occasional grocery list, I don't write things out by hand anymore. It's just me and the keyboards on my laptop and phone. Luckily, my mind still works—sort of. The stuff I produce has gotten better. Using a computer allows me to edit faster. But, I don't retrieve words as quickly as I used to. I find myself using online tools continually during a writing session. I could blame age for the impediment. And that may be the case. But still, a part of me says, "Why remember words when I can just grope around a thesaurus to find what I need?" That I can still spell most words correctly is a bit of miracle. But then again, a computer has been correcting my spelling for the last 25 years.

I'll share another secret: I don't remember phone numbers anymore. At one time, I had all the phone numbers associated with all those

close to me committed to memory. I knew the phone numbers of my sister, parents, in-laws, friends, steady customers and even my favorite restaurants. I didn't have to look anything up online. I just carried the numbers around in my head. Now, the only numbers I have memorized are my own and my wife's. When I want to talk to my sister, I look up her name in the contact list on my cell phone and hit the "call" button. When I am in my bluetooth-enabled car, I just say, "call sister." The machines do the rest.

I can still sum a short list of numbers in my head. Also, I can multiply two numbers together as long as neither number is greater than a thousand. If I want to do multiple operations—say, add some numbers up and then divide by another—I need to use a calculator. I haven't tried to do this sort of arithmetic on paper in a long time. Maybe I can, maybe I can't. Dunno. It's just easier to use a calculator.

I still read a lot. But I find that I spend more time learning things by watching videos on YouTube. In fact, I just got through brushing up on JMeter by watching a playlist of 20 videos on the topic. It took me about two days. I can't remember the last time I spent two days completely engaged in reading a technology book. It's embarrassing to say this, given that I am a technology writer.

But, there is good news here: I can still make change. I learned how to do this before cash registers reported the change to give back upon purchase. You start with the sale amount and work your way through the cash drawer taking out coins and bills until you reach the amount the customer gave you. Funny that I should remember this small piece of mental acrobatics. But, then again, I haven't used a cash register in a very long time. Making change has yet to be made simple for me.

However, the computers I use continually throughout my day make

things very simple. They allow me to write out my thoughts clearly. They tell me when to pay my bills. They correct my spelling. They make going to the grocery store a breeze. I just take want I want from the shelves, put my credit card into the card reader at the automated checkout line and pay only what is due—no cash required, no change made.

Automation has made me really smart in a few areas and helpless in most others. I can design an elegant microservice. I am wicked good at working my way through the ins and outs of Amazon Web Services. I can create the automation code that tests my software so that Jenkins can move everything along the deployment path easily and reliably. Yet, I have no idea how to fix my car when the warning lights go off. I don't know how to repair my cell phone when it stops working. If my voice-responsive TV no longer delivers video on demand, I'm not even sure who to call. The cable company? Netflix? Linksys? Samsung? Denon? When my microwave breaks down, I throw it out.

My world is simple on the surface and yet terribly complex underneath.

At one time, the complexities were more apparent. Information was not at our fingertips. Research meant hours in the library poring over the card catalog. Chemistry was part of professional photography. Acting meant memorizing a script that had to be recited over a period of hours, not minutes. Things were more difficult then. But, we sort of figured it out. We had the ability to negotiate the complexities of life. We had no choice. The machines had yet to be invented.

Now the machines have been invented. Overall, they have been good to us. Smallpox is gone. Lasik is here. Doors open before us automatically, no pushing required. Delivery is overnight, if not same

day. Should I want to run my program on a supercomputer, all I need is an AWS account bound to a credit card. Just 1 percent of the population in the United States feeds the rest of the country. We don't lack for toilet paper.

Technology is a wonderful thing.

But, I can't help but wonder what becomes of a culture when everything is automated to essential simplicity. What happens over generations when we no longer need to know how to write legibly, remember a phone number or make change? How will our minds work when the stuff that used to make our minds work goes away? I don't know. I am still trying to figure it out. In the meantime, I'll leave it up to you to decide.

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AUTOMATION: THIS TIME, IT'S DIFFERENT

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It took about 200,000 years for mankind to be able to figure out how to get an airplane to fly. The event took place Dec. 17, 1903, on a field in Kitty Hawk, N.C., when Wilbur Wright piloted the airplane he had made with his brother, Orville, into the air. The flight lasted for 12 seconds. The aircraft covered a distance of 120 feet. The next two flights went a distance of 175 and 200 feet, respectively. The last flight of the day covered a little more than 800 feet. The plane stayed in the air for 59 seconds, at an altitude never greater than 10 feet, before striking the ground and incurring minor damage.

Although the flights were a significant technological breakthrough, they had absolutely no commercial value. Other forms of transportation could go further and travel for longer periods.

Almost two years later, having learned from their mistakes, the Wright Brothers were able to keep an airplane flying for 38 minutes, covering a distance of 25 miles at a speed of 40 mph. The aircraft was 30 percent faster than a horse at full gallop, but still slower than a passenger train running at an average speed of 60 mph. Commercial viability was in sight.

In June of 1919, 16 years after the Wright's first flight at Kitty Hawk, Capt. John Alcock and Lt. Arthur Whitten Brown of the United Kingdom flew 1,690 miles from Newfoundland to Clifden, Ireland, in a little more than 16 hours. Fifty years later, it took 73 hours and and 5 minutes for the crew of Apollo 11 to fly the 238,857 miles from Cape Canaveral, Fla., to the moon.

Think about it. It took mankind 200,00 years of technological progress to get a plane in the air, but only 63 years after that to travel to the moon. It's pretty miraculous, in a way. Technology does not just move forward. It careens ahead exponentially.

What was the stuff of science fiction in my childhood—think video conferencing—is commonplace today. And it's cheaper than we ever imagined possible. The future possibilities of technology are limitless. Anything can come to be, given enough time.

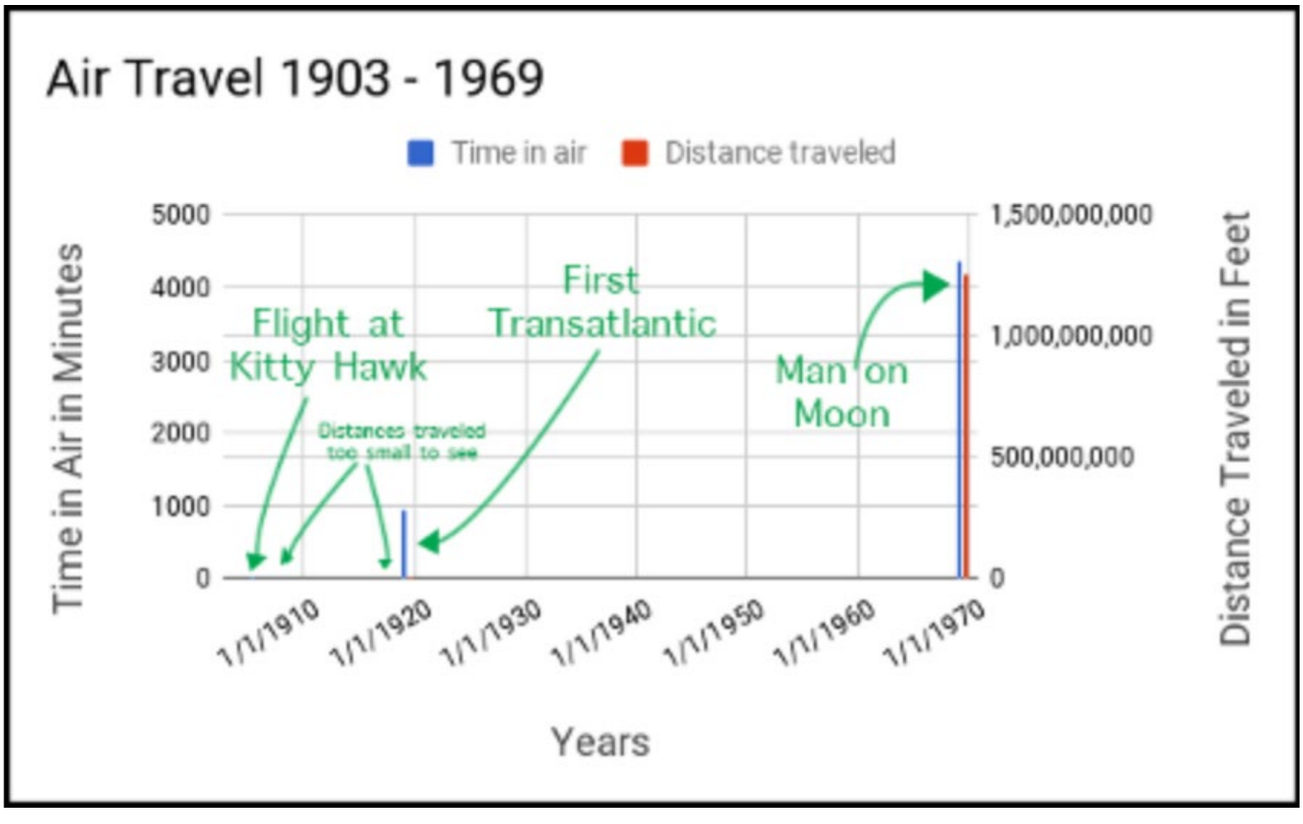

Figure 1: Mankind was able to travel from 12 feet to 238,857 miles by air in 63 years

But, when it comes to considering artificial intelligence and machine autonomy, there are still a lot of people out there who think that the notion of machines taking over most of the jobs that humans do is far-fetched, if not daffy. According to conventional wisdom, history's pattern is that for every job eliminated by technology, more are produced. And should machines displace humans from the workforce entirely, that day is a long way off.

That's what my grandmother thought. She was born in 1900. If you had told her when she was a teenage girl that the flying contraption she was reading about in the newspapers would have the result of putting a man on the moon in her lifetime, she would think you crazy, and rightly so. She had no historical precedent to think otherwise. Remember, in her day horses still pulled plows. Everything except birds and hot air balloons were land-bound. Yet, despite her disbelief, there came a time when she sat in front of a television to watch Neil Armstrong descend from the Apollo 11 Landing Module to put the first human footprint on the moon. She thought it would never happen. And yet, it did.

Yes, the historical pattern has been that technology eliminates jobs and creates new ones for humans to do. When the automobile replaced the horse, the out-of-work blacksmiths went to work in factories that filled the ever-expanding industrial landscape. And, with each wave of technological innovation, there were the harbingers of doom predicting the demise of human labor. Each generation of naysayers uttered, "This time it's different." Conventional wisdom points out that it never is.

That was then and this is now. This is the time of the autonomous machine. This time it is different.

THE RISE OF THE AUTONOMOUS MACHINE

Machine autonomy is the ability for a device to make decisions and conduct itself independent from ongoing instruction, very much the way a human does. The most telling example is an automated stock trading program used by financial investors. The program is at work continually buying and selling stock with the goal of turning a profit. Certain safeguards are built in to prevent disaster. But for the most part, the application is left on its own to achieve its goal: to make money.

Until very recently, machine autonomy was confined to software applications such as the stock trading example described above. However, modern robotics makes it so that not only can a machine "think" autonomously, it now also can move autonomously. The most apparent example is the self-driving car.

Integrating physical and cognitive autonomy into machine behavior changes the game. In prior days, a taxi required a human driver to get the passenger's destination, find the best route, drive the vehicle and collect payment for the ride. All a passenger needed to do was jump in the back seat and tell the driver where to go. The human driver figured out the rest. As technology improves, the passenger still will jump into the back seat, but in an autonomous vehicle that gets routing information and traffic conditions from a wireless connection to the internet.

The ramifications are profound.

For example, let's imagine we have a diseased tree in our front yard that needs to be removed. Today, we call a landscaping company. The tree removal crew shows up, we point to the diseased tree and ask the foreman to remove it. That's the only instruction we need to give. The

landscaping crew has the ability to act autonomously to do whatever is necessary to remove the tree safely.

Now, imagine the crew brings along a robot to help with the task. At this point, it's safe to say that current robotic technology requires a lot of human guidance to remove the tree; the robot is more an aid than an independent worker. The robot might have no other ability than to pick up tree cuttings and take them to a truck to be hauled away. Or, the robot might be able to handle a tree-cutting tool to assist with demolition. Still, the independence of the robot it limited. Either its activities are limited to repeatable tasks limited in scope, or it can act in an ad hoc manner by taking one instruction at a time from a human. The robot is dependent on human instruction to get work done.

However, let's imagine that robot technology is on the trajectory of exponential innovation that has been the historic norm. Remember, in the scheme of 200,000 years of homo sapien activity, 63 years from a field in Kitty Hawk to the moon is but a blip in the historical timeline. Autonomous lumberjack robots are entirely possible.

You call up a landscaping company. A crew of three lumberjack robots show up in an autonomously driven vehicle. These robots know everything there is to know about tree removal and they can do all the physical activities required. The "lead" robot asks you which tree needs removing. You point to the tree. The crew figures out the rest on its own, right down to charging your credit card for work done. Plausible? If you answer no, pretend you are my grandmother and you've just been asked whether you think it's plausible that a man will walk on the moon in your lifetime.

So the question remains, What happened to the human crew? Did they become data scientists? Don't answer this question yet. We'll get

to it in moment. First, we need to talk about the next milestone on the road to complete machine autonomy: artificial general intelligence (AGI).

NARROW AI AND AGI

In the tree-removal scenario described above, all robotic activity—autonomous or otherwise—was confined to a single task: removing a tree. The scope of work is limited. Working within a limited scope of behavior is called narrow AI (artificial intelligence).

Examples of narrow AI are cutting down a tree, trading a stock, finding a date on Friday night, composing a song, making a pizza, etc. We're going to see a lot of narrow AI emerge in the next few years. Venture capitalists such as Khosla Ventures, Greylock Partners and Goldman Sachs are already putting money into advancing narrow AI technologies. However, narrow AI is but a stepping stone to get across the pond to the final destination: general AI.

Think of of it this way: If Kitty Hawk is the starting point of AI, the first transatlantic flight is narrow AI. AGI is landing on the moon.

What will general AI look like? Let's go back to the landscaping example.

We're back in your front yard sitting in some lawn chairs having ice tea on a hot summer's night. A driverless vehicle shows up. Two robots emerge. One approaches you and asks your permission to deposit $500 in your PayPal account in exchange for cutting down a diseased tree in your front yard. "OK," you say, "but how do you know the tree is diseased and why are you giving me $500?"

While the second robot gets to work, the first robot responds, "The county keeps drones in the air 24/7 analyzing the landscape. A drone

did a spectral analysis of your property and noticed the diseased tree. In addition to reporting back the location of the tree, the drone also included a full biological profile. If you don't remove the tree, the disease will spread. That's the bad news. The good news is that it's a cherry tree. And it seems that only 10 percent of the tree is diseased. The rest is perfectly good wood. The price of cherry wood is quite high on the commodity markets right now. Also, there's a legal statute that requires the county to reimburse property owners when a private landscape is altered for general good. So, the county sold a futures contract on the wood it can reclaim from your tree. The $500 we want to put in your PayPal account reflects your share of the revenue received from the futures contract plus the amount of the reimbursement entitlement required by law."

This is what AGI looks like. AGI is the ability for a machine to think in broad terms, using a multitude of knowledge domains. Combining AGI with the advances in physical robotic capabilities expected on the horizon produces a result in which machine autonomy is not only possible, but will exceed human capability.

If you think AGI is a fantastic notion, go talk to Yves Bergquist, CEO over at Novamente. The company is actively working to improve AGI for general commercial use. One application Novamente is developing uses AGI to determine, if not create, movie scripts with a high probability for profitability. To quote Bergquist: "A story is an algorithm."

Making a modern-day Hollywood blockbuster is a billion-dollar undertaking. Given the choice, studios would rather not roll the dice. However, when it comes to scripts, predicting a winner is difficult. Of all the human endeavors that are tough to emulate with artificial intelligence, creative storytelling ranks high. Writing a script requires

working in a multitude of knowledge domains: story, character, plotlines, scene design and historical continuity, to name a few. Narrow AI is not suited to the task. You need AGI. There's too much to consider. In a way, it's surprising to think of Hollywood is the perfect incubator for developing real-world AGI. But it makes sense. AGI might produce a few flops. But, it's a whole lot safer to lose at the box office than to lose on the battlefield.

Given companies such as Novamente, the entertainment industry might well become the incubator in which AGI is perfected. Then, if the trend in rate of technological innovation continues, eventually AGI will become viable everywhere. Then what? What happens when a machine can do everything a human does only faster and better?

A TURKEY'S LIFE

Understanding the long-term impacts of a given technology has not been one of the highlights of human endeavor. As cars became commonplace, few people considered the possibility that too many would create too much carbon monoxide and thus threaten the health of the earth's population. And nobody really thought about what was going to happen to the displaced blacksmith who was no longer needed to make shoes for a diminishing number of horses. Events just ran their course with little or no forethought.

But, it's getting better. Some people do think ahead. Military planners consider the improbable as do financial analysts. It's called risk analysis. These are the people that get paid to think outside the box, so to speak. They understand the even small possibilities might happen. Whether they are heeded or not is another story.

Today, machine autonomy is real. The possibility exists that in our lifetime automated AI will indeed be able to do everything a human does. And, the machine will do it better at less expense. There will be no

new jobs for humans to do as old ones are destroyed. A machine will be able to do the new job faster and cheaper—even those jobs that require a significant amount of AGI. Then, what will happen to the humans?

We have to think about it today!

Sadly, few are. We are not hearing any articulation in general industry or in government, at any level, about ideas to address the the impact of automation on human employment as machine autonomy and AGI become more prevalent in the economy. It seems as though most people are relying on the old logic of the conventional wisdom.

Conventional wisdom is easy to accept. The U.S. economy is reported to be at practically full employment levels. Employers are complaining about how difficult it is to find qualified workers. The stock market is achieving historic heights. Given history and current events, of course it's reasonable to say there always will be jobs for humans to do.

This assertion works until the day fully autonomous machines appear on the landscape. Then, conventional wisdom will be that which is uttered by turkeys on the day before Thanksgiving.

What do I mean? Allow me to elaborate using a previously written analogy.

Imagine you are a turkey on a farm. Every day the farmer comes by to feed you. This goes on for one week, two weeks, 10 weeks. Given your history, you are completely justified to predict that your future will be one of satisfying meals. It's always been this way; how could it be otherwise? You go day in and day out predicting that the next day will be full of food and sunshine. You are correct … right up until the day before Thanksgiving.

In other words, there are things that happen independent of historical precedent. The trick is to imagine what such events might be.

Everybody agrees that AI is here and that machine autonomy is growing. The conventional wisdom is that, based on historical observation, there have always been jobs as technology grows. Many think the full replacement of human labor by autonomous machines is a possibility, but one that is coming in the far, distant future. When Wilbur Wright took off in 1903, my grandmother's distant future as was 1969. Those 63 years passed in no time. She lived to see a man land on the moon. Those of us alive today are seeing the beginnings of true machine autonomy appearing on the technology landscape. A world of full machine autonomy is more than probable in the lifetimes of our grandchildren. It will happen. What will be the impact? What will they do if their labor is no longer required?

Back in 1903, as automobiles began to chug along the planet's roads, we missed predicting the possibility of air pollution and global warming. Today, will we allow conventional wisdom to prevail and miss preparing for the impact that full machine autonomy will have on human employment? Or will we plan ahead? Hopefully, we've learned from our mistakes.

I'll leave it to you to decide.

Author's Note: *The analogy of prediction in terms of historical precedence is taken from the book,* "The Black Swan," *by Nassim Nicholas Taleb*

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UBI: FACING THE REALITY IN THE ERA OF AUTOMATION

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Those of us working in DevOps make a good living. According to Glassdoor, the national average salary for a DevOps engineer in the United States is $100,000. Are we worth it? Of course we are; DevOps is hard work. The value we add to an organization more than justifies the salaries we can command. Nobody is giving us the money. We have to earn it every day.

Considering that high school teachers earn on average $48,000, a restaurant manager averages $46,000—about the same as a paralegal—and a forklift driver makes $26,000, DevOps engineers are doing A-OK.

That's the good news. The bad news is that our average salary, combined with our commercial isolation from others, puts us in a bubble. I am the first to admit that I live in that bubble. I don't interact with a lot of paralegals, restaurant managers and forklift drivers in my day-to-day work. Most of my interactions are with people who do what I do and live the lifestyle I live. It's nice to live in the bubble; I've done countless all-nighters to be here. But I am very aware that it's a place that few people live. Keep in mind, the average income in the United States is $51,272.

It takes a lot to get into our bubble. You need to be really smart and you need to be well-educated. Most programmers have a college degree. Yes, there are few of us that are part of the 70 percent of the population that does not have a college degree, but those people are rare. And, for as long we keep delivering and learning the new stuff that comes down the pike, we'll be living in the bubble for the foreseeable future.

However, for those outside our bubble, it's going to be a different story. As the evolving landscape reveals, those who do predictable, repetitive work are going to be automated away. And, most of the jobs that do remain are going to be on the lower end of the income scale.

So, what's to become of those outside the bubble? How will they survive?

One solution that has been bantered about is Universal Basic Income (UBI). UBI is income that you get by virtue of being a citizen of the state. There are no strings attached. Every month a deposit appears in your checking account and you are free to do with it as you wish. If your refrigerator is empty, you buy food. Should you earn a good salary, you can give the money to a favored charity or buy your kid a new video game. As I said, it's no strings attached. The intention is to provide financial security to the citizenry without means testing.

UBI has been in play in Alaska since 1976 as implemented under the Alaska Permanent Fund. Every permanent resident of Alaska gets money from the state just because they live there. In 2014 every resident of Alaska got $1,884 from the fund.

Other governments are trying or have tried out UBI. Finland has a limited experimental program that pays €560 ($630) a month to participants. Cyprus pays out €480 a month ($546) to qualifying

citizens. Canada had an experimental program back in 1974 that ran for four years in Dauphin, Manitoba. The program was called Mincome. It dispersed $1,200 a year to people living below the poverty line.

UBI has it supporters. Former U.S. president Richard Nixon supported it for a while. Milton Friedman supported it via the negative income tax. And tech leaders including Mark Zuckerberg and Elon Musk, men who have a keen understanding of the impact of automation on human employment, are proponents.

I am a supporter, too, if for no other reason that I believe in the promise of technology—that we will automate our way to a life in which we are free to do the work that brings meaning and purpose rather than going through the motions of existence, laboring away to put bread on the table.

But, for as much as I think UBI is valuable, there is a part of me that finds the notion to be a farce. It's not so much because I think people will take the money and go down to a riverboat casino to gamble away their monthly allocations while the kids go hungry, but rather because the dollar amounts being considered for allocation are a joke.

Let's do the math.

The table that follows illustrates how much income is required to support a family of two adults and one child on state-by-state basis. This data is provided using the MIT Living Wage Calculator by way of Mental Floss.

STATE	MIN. INCOME PER YEAR	PER MONTH
West Virginia	$45K	$3.75K
Iowa	$49K	$4.09K
Montana	$49K	$4.08K
Tennessee	$47K	$3.91K
Alaska	$54K	$4.50K

Table 1: A listing of minimum income by select states

The states I choose—West Virginia, Iowa, Montana, Tennessee and Alaska—don't contain any big cities on the order of New York, Los Angeles, Houston or Chicago. Let's just say they're states not subject to a large amount of urban impact. These are states that I can image might find UBI a useful program, particularly as industries—manufacturing, agriculture and energy—become more automated and the employed workforce experiences more displacement due to automation.

As you can see in Table 1, according the the MIT Living Wage Calculator, it will cost a family of two adults and one child residing in any of these states about $4,000 a month to live at a comfortable minimum.

Let's apply some UBI numbers. As mentioned above, in 2014 the Alaska Permanent Fund distributed $1,884 a year to each permanent resident in the state. That comes out to a monthly allocation of $157. Compare that $157 a month to the $2,250 each working adult in the Alaska household has to earn to achieve a modest standard of living. That $157 is 7 percent of the amount needed. It's a joke. The reality is that the allocation from the Alaska Permanent Fund will buy about a week's worth of groceries, if that.

On the other hand, there is Cyprus. As mentioned above, that

country is paying out $546 per person in guaranteed income, which is an OK allotment given that the rent on a three-room apartment is about $500 a month and a McDonald's Combo Meal goes for around $7. Multiply the per-person allocation of $546 by two adults and you have a situation where life is sustainable. But then again, the population of Cyprus is 1.2 million people, a little more than the size of the population of Montana. Still, the Cyrus UBI amount is a viable number. But, what about here in the United States? If we were to implement UBI, what is the dollar amount each person is to be given?

Let's go back to Table 1. For the residents in those states listed to enjoy a standard of financial security on the order of Cyprus—one in which no matter what, you will have your basic needs met—it seems that we will need to come up with a UBI allocation of about $20,000 a year per adult. Of course, this is assuming that the person does absolutely nothing in the way of earning money beyond the UBI allocation. However, as was reported in the study of the Mincome Project in Dauphin, Canada, once UBI kicked in, only two segments of the workforce worked less—new mothers and teenagers.

Granted, this is very limited study of a very small sample of people from over 40 years ago. But, still the inference may be valid. Also, as we've found from people in retirement or forced unemployment, after a period of welcome inactivity, at some point we need something to do. Thus, there is a good chance that those on UBI will want to earn money beyond the allotment. Given that we can project that most people on UBI will want to engage in income-producing work, if such work is available, then maybe that $20,000 a year number is excessive. Maybe a reasonable dollar amount for UBI is between $12,000-$15,000 per year, per person. That number could work in less-expensive areas of the country.

How would we pay for it all? Honestly, at this point, I don't know. Maybe the same way we paid to put a man on the moon? To quote the old saying, "Where there is a will, there's a way."

Sadly though, no matter what the allocation number is and no matter what the consequences of not doing UBI may be, the will to do UBI currently is limited to a bill before the Hawaiian Legislature. The general will is not there for a variety of reasons: politics, moral distaste manifested as a fear of Netflix-induced sloth in the general population, or just plain greed. The notion of having enough money show up in a citizen's checking account to ensure a modicum of financial security has limited appeal.

I can accept such reluctance. UBI is far afield from where we are culturally or where we have been historically. But, what I cannot accept is formulating a UBI program that is dumb; one in which we create stories that say financial security can be had for $157 a month. UBI allocation needs to be proposed in real, livable numbers. Otherwise, the risk we run is that when we can somehow sell the idea to a willing buyer, should UBI fail due the stupidity of not allocating enough money per recipient, we will be hard-pressed to get a second chance to do it right.

The notion that the impact of automation on human employment will be severe is a tough one for many to accept. While it is true that history shows that advances in technology have led to new forms of employment for those displaced, history does not accommodate thinking machines. Thinking machines are new to the landscape.

Just as automobiles replaced horses, maybe thinking machines will replace humans. Horses did not find new forms of employment when the automobile came along. Rather, their number diminished to levels

required for their remaining purpose: providing entertainment. Such an analogy might sound harsh. After all, a human life is worth more than its commercial value. If this is the case, then unless humanity can implement ideas such as UBI as a way to sustain life independent of commerce, the alternative might very well be about the bubble—a place where those on the inside live well, in secure isolation from the less fortunate ones suffering on the outside.

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WHEN AUTOMATION PREDICTIONS COME TO BE: TRANSPORTATION AS A SERVICE

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Back in December of 2016 I wrote an article for DevOps.com titled, [“What Do We Do When Everything is Automated?”] ***in which I made a prediction:***

“Also, think about this: As Uber and Lyft mature in the business landscape and self-driving cars become commonplace, the ride-share companies will replace human-driven vehicles with self-driving vehicles. Then, Uber or Lyft will start to offer a pricing model that is a flat fee for 24/7 service with unlimited mileage.”

Pretty brazen prediction, huh? Well not really. I thought and still do think that such a situation is inevitable. You just have to think things through to arrive at the conclusion I made above. However, my thinking was that, until yesterday, this sort of inevitability is about five years out. Then this news flash come in from Bloomberg: [“Apple Is Working With Hertz to Manage Its Self-Driving Car Fleet.”]

This caught my eye. Hertz stock went up 14 percent that day. Upon further inspection, I learned that Apple is leasing a small fleet of

cars from Hertz to test self-driving vehicles. Turns out the Alphabet Inc., a.k.a., Google, has a similar deal with Avis Budget Group Inc., a competitor to Hertz in the car rental space. Now granted, I thought that Uber or Lyft would extend the scope of their activity by working directly with automobile manufacturers making self-driving vehicles. That the service provider might be a current automobile rental company was a bit unanticipated. But, as I explored further, it gets interesting.

I turns out that Hertz previously was owned by Ford Motor Company, which sold the company to a private equity group in 2005 for $15 billion, a tidy sum. Hertz acquired Dollar Thrifty in 2012. Avis Budget Group, a competitor to Hertz, owns Zipcar as well as the New Zealand rental company, Apex Car Rental and Maggiore Group, the fourth largest car rental company in Italy. There's a lot going on in the auto rental space.

As I reflect upon events, things become clearer. It makes sense that those non-automotive companies working to create driverless vehicles are attracted to car rental companies. Car rental companies are not in the automobile business. They are in the transportation service business. Few people go to Hertz to rent a Chevy. They go to rent a way to get around. If a customer shows up at the Hertz counter only to find out that there is no Chevy to be had, most people will take the Nissan alternative. They don't care about the car. They care about the service the car provides.

Now imagine this: Let's say you are a vehicle manufacturer, new to the marketplace. You finally figure out how to make a driverless vehicle that satisfies the needs of consumers under most driving conditions. Given current trends, when it comes time to make a profit from your investment, are you going to open showrooms with the hope of selling

your new automotive brand to consumers? Or, are you going to buy an existing company that has a proven record success and infrastructure for providing transportation services on demand to the masses? In other words, what's easier to imagine, Apple setting up showrooms throughout the world to sell autonomous vehicles to consumers accustomed to buying Ford, Toyota, Nissan or Tesla? Or, rather, Apple going directly into the autonomous transportation-on-demand business by buying Hertz? Or maybe Hertz will just buy driverless cars from Apple. (Hertz buying from Apple is hard to imagine; Apple is a company that likes to think big. Selling cars to Hertz is thinking small.)

My take? Well, two things: First, as autonomous vehicle technology matures, transportation as a service is going to grow on the landscape. Vehicle manufacturers need to survive. They will adapt. How the actual selling of vehicles fits into it all is still working itself out. I think we're going to see a lot of vehicles being made to provider of service, not as a property to own. Second, maybe it's time to buy some stock in Hertz, maybe Avis too, for that matter.

What do you think?

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HUMANS: THE ULTIMATE EXCEPTION HANDLERS. UNTIL ...

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Back at the turn of the century, I had a job working in the IT department of a Big Bank. The section I worked in was Mortgage Exceptions. My group's task was to route exceptions that could not be addressed by the mortgage processing system to a human being for resolution.

Most of the intelligence required to execute the Big Bank's mortgage business processes was automated by the mortgage system. Each month the system processed millions of mortgage payments. The systems sent out the bills for payment. And, when a payment came in, a human operator entered the check payment into the system. (This was before the days when direct withdrawal was the norm.) Most people paid their bills. So, for the most part, the system chugged along without a hitch. But every so often there was a problem the system could not handle—an exception, if you will.

Examples of exceptions were accounts that were significantly past due, account numbers that were unknown to the system, customer complaints and bounced checks. There was a whole array of stuff that could—and did—go wrong that the software could not handle. Thus, the exception ended up in front of a human being. The human was the

ultimate exception handler.

I worked on that system more than 15 years ago. I think it's safe to say that today the bank's system intelligence is a lot smarter. I imagine that today the IT group I worked in is more concerned with writing more robust, automated exception-handling than routing problems to humans.

That's the way technology goes. Systems get smarter and, in many cases, become better than humans when it comes to doing work that is well-known and repetitive. The more the machine can do, the more the machine will do. Businesses like machines—always have, always will. Automation is a good investment.

Those of you who have been following my writing on DevOps.com know that I am very concerned with the impact of automation on human employment. I saw the writing on the wall when I read the Ball State study. As time goes on, more machines will be doing more work. Less human labor will be required. What will those displaced humans do?

Many believe that automation will create new jobs for humans. In some cases, it will. As I said earlier, I am sure the people who were writing the routing code at the Big Bank I worked at years ago are now writing more robust exception handlers that require less human interaction for resolution. Those few developers writing the exception handlers are probably doing just fine. The developers who were writing simple if-then rules, with no ambition otherwise, are probably gone. Also, I'll bet the the Big Bank has embraced the DevOps sensibility, which probably has resulted in those with lesser talent in terms of implementing automation being shown the door. As for those humans who were entering checks into the system and turning

delinquencies over to collection agencies, their number is probably now a handful, if any. Hopefully, the poor soul who was hired as a teller out of high school and worked her way into mortgage exception resolution adapted, despite the odds.

As I said previously, many believe that automation will create new jobs. There always will be new things to do or things that need to be done that machines can't do. Fair enough. Still, for me it's not about new jobs being created. It's about the number of new jobs that will be created.

Many of the new jobs will require a lot more smarts than did the jobs they are replacing. And my gut tells me that, while there will be new jobs, there will be fewer than the number of old jobs eliminated. And these new jobs will fall into two categories: "Cool New Work" and "Doing Work the Machines Have Yet to Master." The "Cool New Work" is just that. "Doing Work the Machines Have Yet to Master" is handling exceptions, the work I used to route to humans back at the Big Bank. Except this time, as systems become smarter, many of the exceptions these systems throw will become a lot more difficult for humans to resolve. The systems will throw fewer errors, but when they do, watch out!

Exception-handling has been in the realm of advanced human activity since the days when the ancient Mayans needed to figure out a way to build pyramids that didn't fall down. A lot of buildings fell down before a few stood up. Eventually, they figured it out. Exceptions gave way to learning, and today we have the art and science of architecture. The industry has matured. Today, constructing a building is more about process and technology than figuring out what went wrong with the last building.

So, too, will it be with automation exceptions. Just as over time fewer pyramids collapsed, with automated systems fewer exceptions will be raised and fewer humans will be needed to figure out what went wrong. Then, we'll be back to where we seem to be going: more machines doing more general work, a smaller number of very intelligent people doing more advanced work, and the rest of us doing the tasks the machines can't do yet—aka, the exceptions. We'll be working on exceptions until the time that the thinking machines will be able to resolve those exceptions. Then what? Dunno.

Now, don't get me wrong. Technology is good; automation is good. There's more to life than spending most of one's waking hours entering check deposits into a mortgage system. Humans were meant for more. But, when earning a living means being really smart or being just one step ahead of a machine, it's going to be a real challenge for the Average Joe to the find opportunities to earn a buck, let alone find a job. How will we meet this challenge? This I leave for you to determine.

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AUTOMATION: A FEW DECADES OF PAIN? OR, WHAT DOES JACK MA KNOW THAT I DON'T?

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Recently I came across three articles that gave me pause. Each article was a bit disconcerting on its own merit, but when I considered them together, the result caused more than a momentary worry. One article was report in Bloomberg Technology ***quoting Jack Ma, head of Alibaba, the second richest man in China and a major player in the e-commerce space. He said:***

"In the next 30 years, the world will see much more pain than happiness."

Ma was referring the impending effects of automation and e-commerce on the economies and societies of the world .

The second was from a piece written by Martin Neil Baily and published by the Brookings Institution in 2015. The article is titled, "U.S. manufacturing may depend on automation to survive and prosper." Here is the quote, referring to U.S. manufacturing:

"The manufacturing sector is still very much alive and reports of its demise are not just premature but wrong. ... The sector will be revived not by blocking new technologies with restrictive labor practices or over-regulation but by installing them—even if that means putting robots in place instead of workers."

The last piece is by Joe McKendrick over at ZDNet. The subtitle to his article titled, "Containers, DevOps, IT automation seen as antidotes to complexity," says it all:

"Seven in 10 IT professionals agree: if we don't automate, we die."

When I put the ideas in the articles together, I get a thought that goes like this: In the coming decades more automation will be put in place, a good many workers are going to be displaced by robots, and it's going to be a world of pain.

Do these notions seem far-fetched? Maybe not. The need is there, the will is there and the money has been allocated. The result is going to be great for the bottom line. For humans and workers, not so much.

But, a thought is not reality. There are many people out there saying that automation is a blessing and in the short and long term, most of us will do well. Automation will create more jobs than it destroys.

PREDICTING THE FUTURE IS A RISKY BUSINESS

Predicting the future is a risky business. Could anybody have predicted that the underlying technology that powered Netscape back in the 1990s would produce today's internet of things? Who would have thought that the first cell phones, selling for around $4,000 in 1984, would lead to mobile devices becoming the dominant computing device today? Not many. To quote Yogi Berra:

"It's tough to make predictions, especially about the future."

Yet, the three predictions I describe above bothered me. I wondered, Do these guys know something I don't?

So I decided to do take a look at some data.

WHAT THE DATA SAYS

One of the metrics that I have found particularly interesting when considering automation is the relationship between the number of employees a company has and its revenue. This number is sometimes referred to as Revenue Per Employee (RPE). The simple assumption is that companies that have high revenue per employee are more productive because that productivity is realized via tools and machines; in other words, automation.

Using data in both the NYSE and NASDAQ stock exchanges, I determined the Top 100 companies with the highest RPE in a given year. I excluded from consideration companies that had fewer than 1,000 employees. (A publicly listed trading company that deals in precious metals, with 30 employees generating revenue of $120 million will create a distortion that is atypical to the norm.) I looked at each year between 2007 and 2017. The result is shown in Figure 1, below.

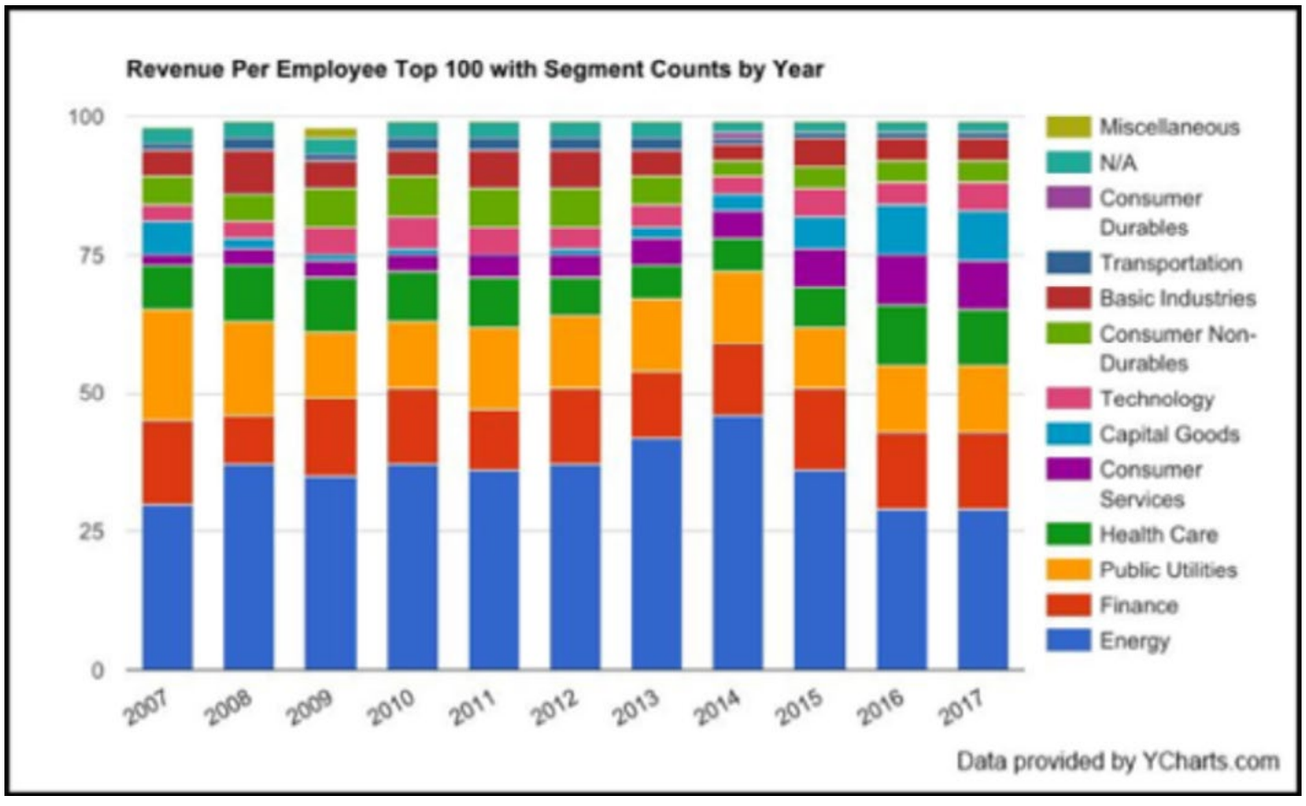

Figure 1: Top 100 Companies by Revenue Per Employee excluding companies with less than 1.000 employers

Given the large representation of the Energy sector in RPE, I decided to look at the Top 10 companies in terms of revenue from 2007 to 2016 to see if there was any correlation. I grouped the Top 10 revenue earners into sectors. The result is shown below in Figure 2:

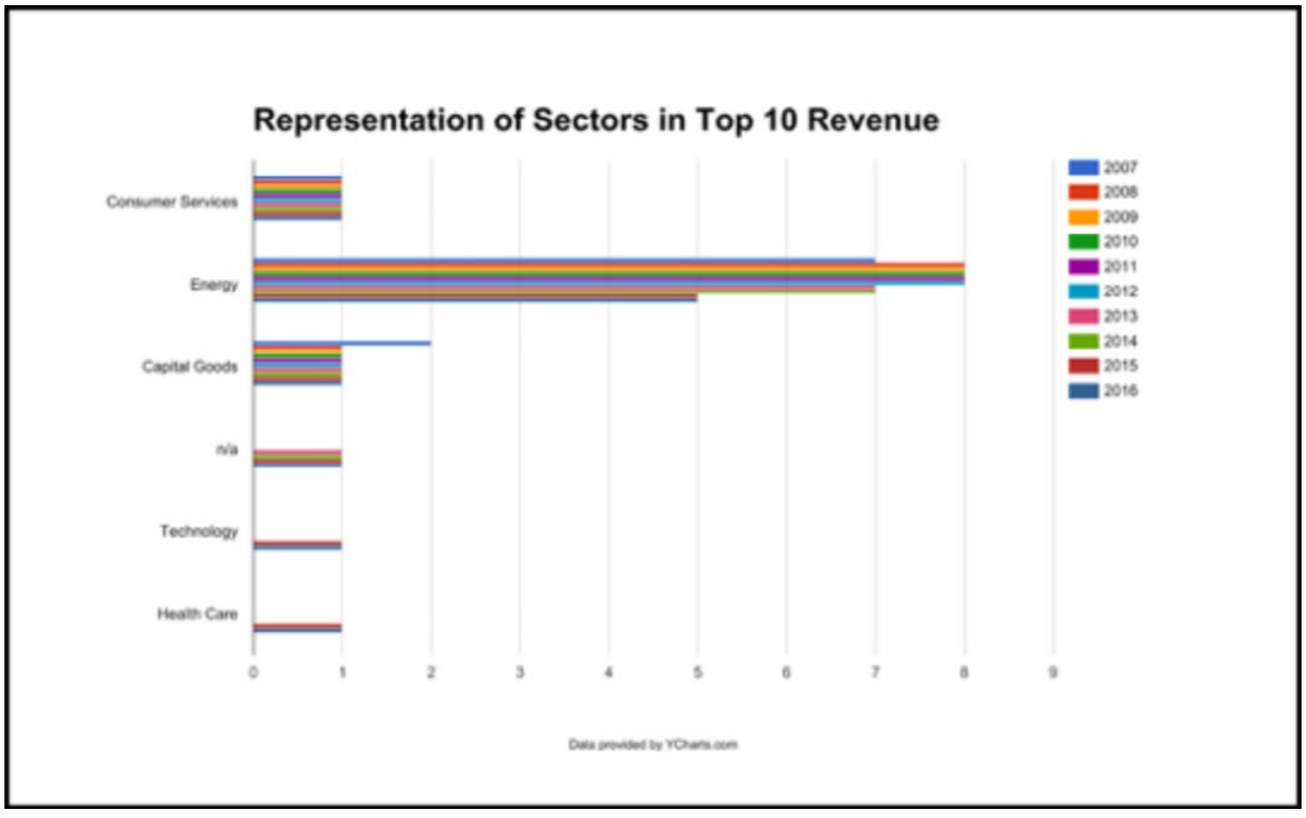

Figure 2: Grouping of Top 10 Revenue Earners according to sector 2007 - 2016

Notice that companies in the Energy sector have the largest representation in the Top 10 revenue earners throughout the years. This pattern is somewhat similar to that of representation of Energy shown Figure 1, in that Energy has the largest representation. There is a correlation.

AN ASSUMPTION PROVED FALSE

My initial thinking was that there is something going on in the Energy sector that might be relevant to my simple assumption about RPE: The greater the RPE, the more automation in force. I looked that the individual RPE performance of Royal Dutch Shell (RDS.A), ExxonMobil (XOM) and Chevron (CHV), three companies in the Energy sector that always appeared in the Top 10 Revenue Earners from 2007-2017. I compared each company RPE to its Total Employees. Figure 3 below shows my findings:

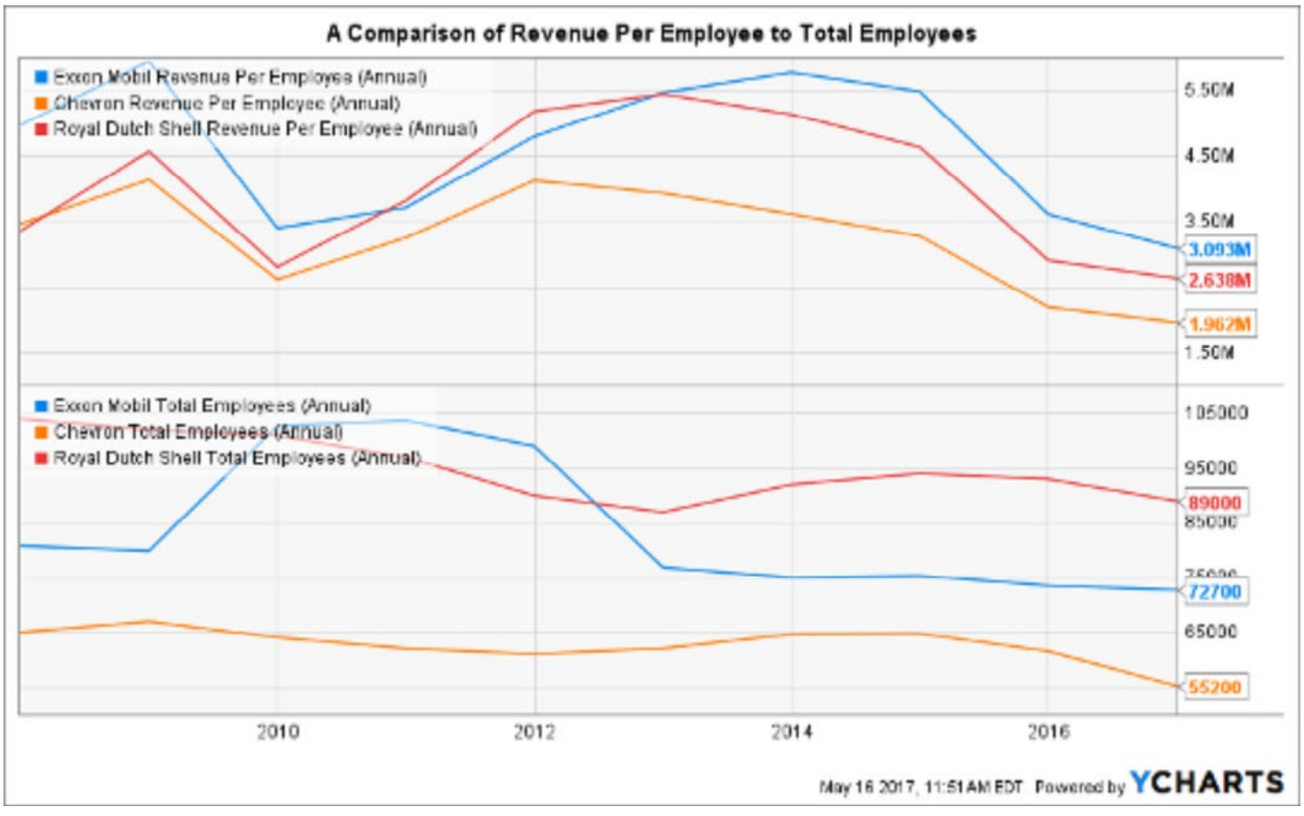

Figure 3: Revenue Per Employee and Total Employees for ExxonMobil (XOM), Royal Dutch Shell (RDS.A) and Chevron (CHV)

As mentioned above, my initial assumption is that as automation increases, RPE should increase, while employee count remains steady or decreases. Figure 4 below illustrates the assumption.

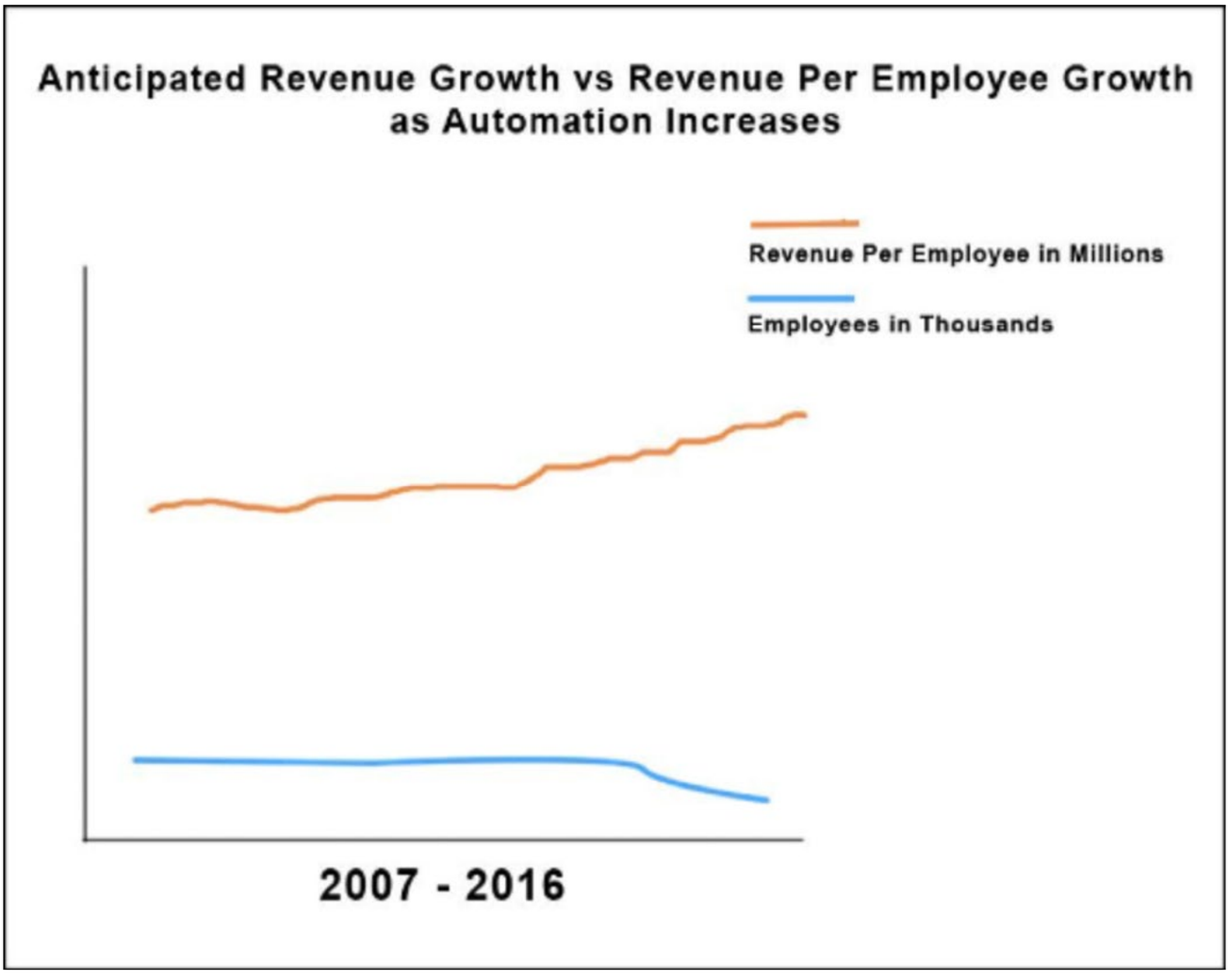

Figure 4: One might assume that as automation becomes more prevalent, fewer employees should produce more revenue per employee

Yet, as you can see in Figure 3, the numbers did not confirm my assumption. We see a significant dip in RPE from all three companies around 2010, while ExxonMobil acquired more than 20,000 employees. Also, we see that Royal Dutch Shell and Chevron have a decline in the number of employees over the number of years. If the efficiency that automation might be attributed to RPE were in force, revenue numbers would at the least mirror employee numbers, or hopefully increase due to more productivity achieved through automation. But revenue does not continue to map to increased revenue versus the number of employees. Revenue is all over the place.

I was stumped until I considered the impact of price of oil. When I compare revenue to the historical price of oil according to Brent Crude Spot Price to oil company revenue during the years in question, a similarity occurs, as shown in Figure 5, below.

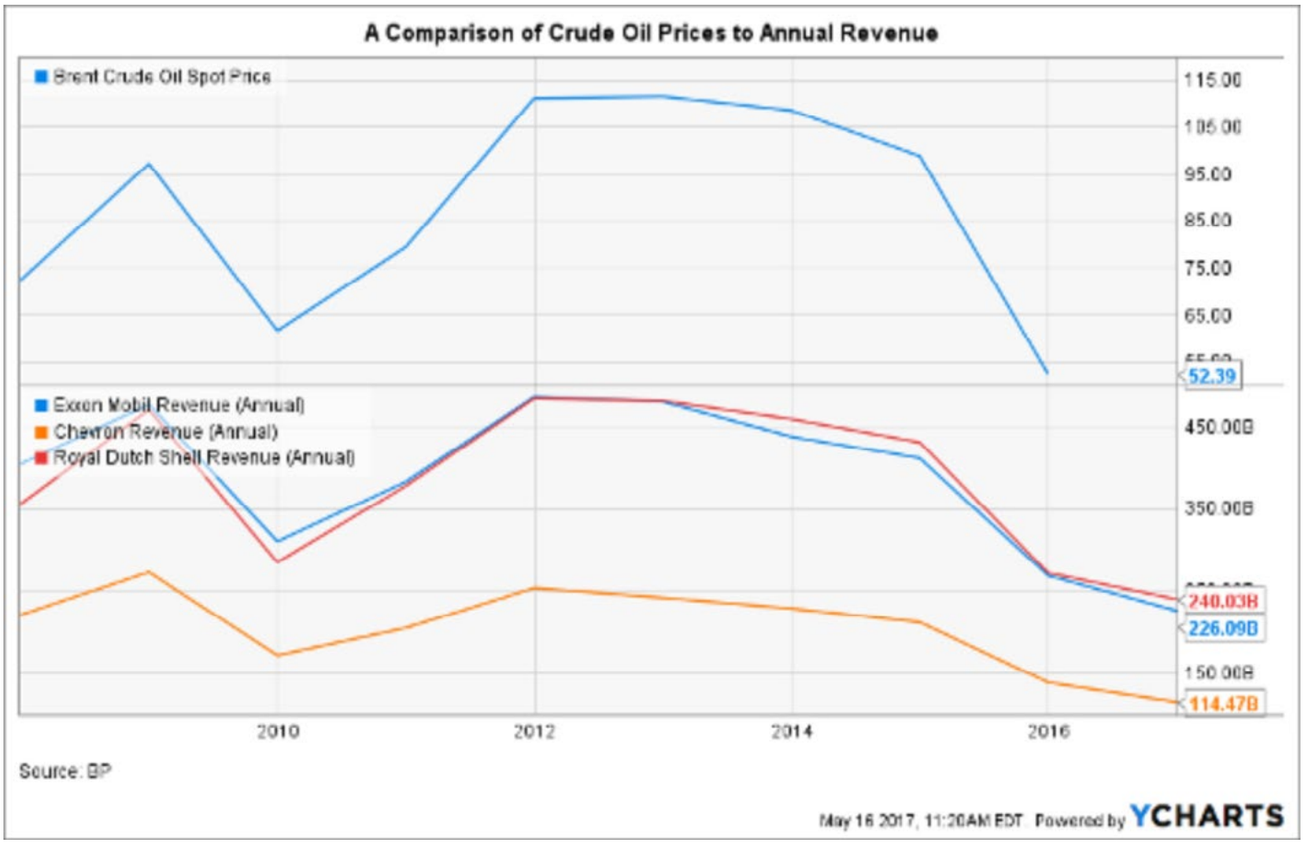

Figure 5: Oil Company Revenue compared to Price of Oil, 2007-2015

The shape of the lines in the lower chart in Figure 5, Revenue in Billions and the shape of the line for oil price, in the top chart look similar.

A reasonable inference can be made that the while oil companies enjoy a sizeable return per employee due to capital investments in tools, technology and automation (ExxonMobil returned more than $3 million per employee in 2016, for example), market price conditions have a more significant effect on revenue.

So it seems that in terms of the Energy sector, for this admittedly

small sample size, automation does allow for significant revenue, but does not increase revenue by way of increased efficiency in terms of operational production. I went back to being stumped. When Jack Ma was talking about decades of pain, was he talking about continuing slump in revenue from the Energy sector? Or was he talking about something else? I decided to look at some data about the world's largest commercial employer, Wal-Mart.

ALL ROADS LEAD TO WAL-MART

Wal-Mart employs more than 2 million people and is the leading revenue earner for the years 2014-2017. Yet, when we look at its RPE compared to other companies, Wal-Mart is at the bottom of the stack, as shown in Figure 6, below. As mentioned above, in 2016 Exxon earned more than $3 million per employee. Amazon had an RPE of ~$475,000. JPMorgan Chase came in at ~$401,000. Wal-Mart? $211,000. To put it in perspective, ExxonMobil did more than ten times as much in terms of RPE.

I could not help but wonder, why does ExxonMobil have a higher RPE than Wal-Mart? Or, for that matter, why so to for JPMorgan Chase and Amazon? I have a theory to propose to answer the question.

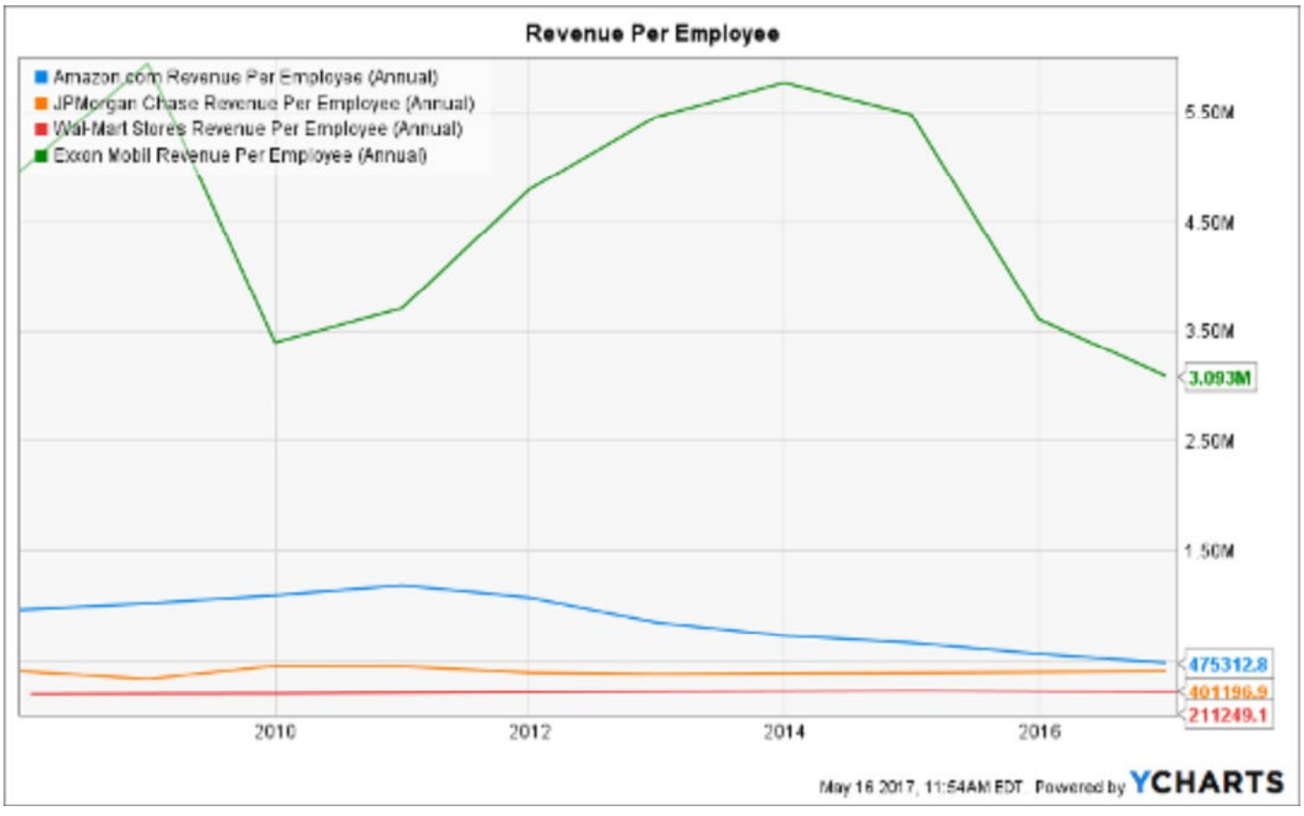

Figure 6: Wal-Mart's Revenue Per Employee of $211,000 in 201y puts it well below others

Energy, Finance and Amazon have historically been heavily automated industries. The size of a land-based crew drilling oil is between four to six employees per eight-hour shift. These people are not out there with picks and shovels. They are operating big machines with each machine having some amount of automation built in.

Once the well is drilled, there is some maintenance labor, but revenue is derived from what comes out of the ground. A lot of machinery is used to get the oil out of the ground, processed and delivered for end use. Hence, a large automation factor. Human labor is secondary.

Same with Finance. Computers have been at the heart of Finance industry—banking, investments and insurance—since the first mainframes were put into action. Is the revenue of some companies in the Finance sector subject to the whims of the market? Most likely, yes, particularly as one considers the events of 2008. But again, one trader with a single Bloomberg terminal can do a lot of work.

And Amazon? The company has been the poster child for automation since Jeff Bezos sold the first book online.

Still, as noteworthy as the facts were, there seemed to be no historical precedent to justify Jack Ma's prediction doom. But, the dreadfully low RPE of Amazon might give us a clue. So went back to the drawing board and spent another afternoon making charts using data from NYSE and NASDAQ.I came up with the two charts you see in Figure 7 below. Then, the plausible became possible.

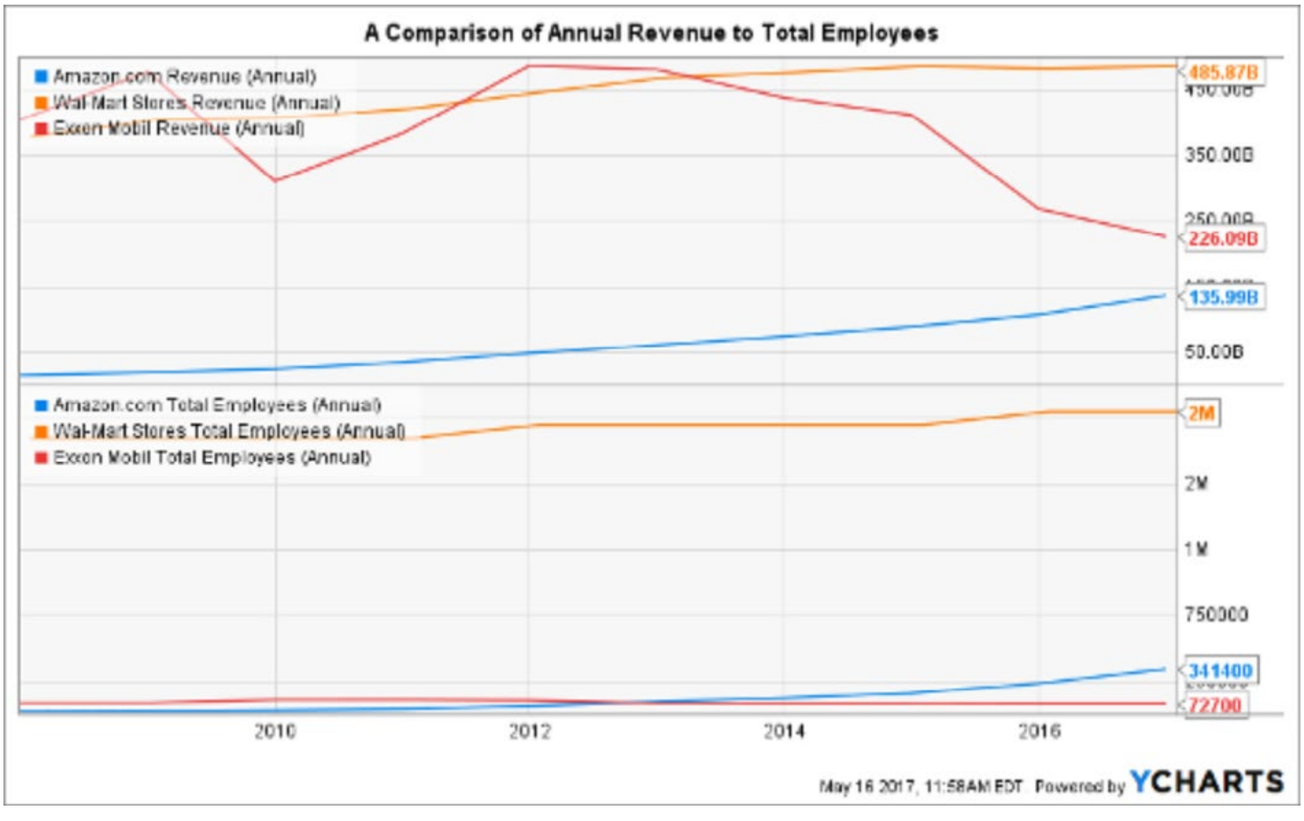

Figure 7: Total Employees and Revenue: As Wal-Mart hires more employees revenue begin to flatten; Amazon revenue increases

THE PLAUSIBLE BECOMES POSSIBLE

The chart on on the top of Figure 7 below shows the annual revenue for Amazon, ExxonMobil and Wal-Mart. The chart on the bottom of the illustration shows the total employees for each company. The time span of each chart is 10 years. Wal-Mart shows a steady rise in revenue

until 2016 when things start to go flat. ExxonMobile starts to lose revenue in 2012, while its total employee count remains relatively even. Amazon, on the other hand, shows a steady rise in revenue, as well as a rise in employee count. Both Amazon's total employee count and revenue grows at a steeper growth trajectory than Wal-Mart.

Is there something going on?

Well, when we look at net income, there very well might be. Figure 8, below shows the net income of ExxonMobil, Wal-Mart and Amazon. This is where the rubber hits the road. Net income is the money that's left over after all expenses and taxes have been paid. It all comes out in the wash when you look at net income. You can be a company doing $1 billion in revenue, but if your expenses are $999 million, your company is doing no better than one doing $10 million in revenue with $9 million in expenses. In terms of Amazon, Wal-Mart and ExxonMobil, as we move to the later years, 2016-2017, the numbers come into the same ballpark. And, in that ballpark Wal-Mart is showing some decline, ExxonMobil is showing a continuing big decline. Amazon is on the rise.

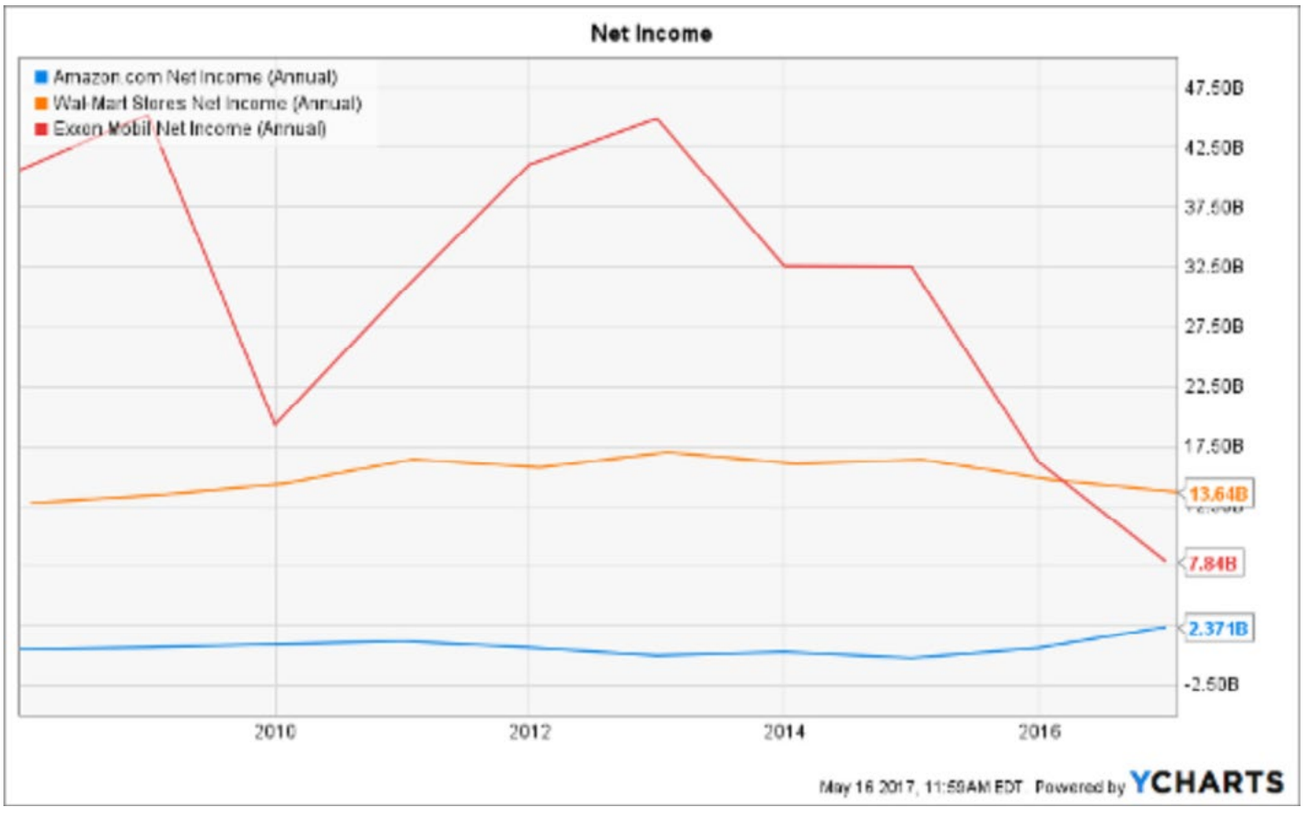

Figure 8: Net Income: Wal-Mart and ExxonMobil show declining net income while Amazon is on on the rise

So now is a good time to go back and review the assertions made at the beginning of the piece:

- Jack Ma: ***"In the next 30 years, the world will see much more pain than happiness."***

- Brookings Institution: ***"even if that means putting robots in place instead of workers."***

- Joe McKendrick: ***"Seven in 10 IT professionals agree: if we don't automate, we die."***

Given that data presented, we see that industries that have a good deal of automation, Energy and Finance for example, have a high degree of employee efficiency as reflected in RPE. Also, we see that Energy is subject to the whims of market pricing. And lastly, we can

see the country's largest employer, Walmart, has poor RPE numbers, while Amazon, in many ways analogous to Wal-Mart in that Amazon has a significant presence in the retail space, albeit the online retail space, has very good RPE and increasing net income.

Will Amazon continue to hire? A reasonable assumption is yes. Will Exxon continue to hire? If you go back to Figure 7, you will see that ExxonMobil employee count has been declining since 2010. Couple this fact with a continuing decline in revenue, we're not going to get fired if we say that ExxonMobil is probably not going to increase employee count unless some sort of miraculous business pivot happens. But what about Wal-Mart?

Wal-Mart has 2 million employees, a dreadful RPE number and declining net income. What will happen should Wal-Mart's CxOs decide to more fully embrace automation? After all, hiring more people does not seem to help. It hired more and revenue declined. It's a pretty good bet that Wal-Mart will go more toward the full automation end of things. How else will the company survive? So let's play out this scenario.

A CLOSING HYPOTHETICAL SCENARIO

Let's close with a hypothetical scenario. Let's say that somehow Wal-Mart magically figures out a way to increase its RPE from the current $241,000 to $475,000 within the next five years. ($475,000 is the current RPE of Amazon.) And, let's say that Wal-Mart's revenues continue to stay level at the current $482 billion a year. Thus, to calculate the number of employees required to achieve the desired RPE, we use the formula:

$475K (RPE) = $482 bln/Number of Employees

When we do the math, the number of employees that Wal-Mart needs to achieve $482 billion in revenue with an RPE of $475,000 is 101,4736,842—about half the size of its current workforce. Think about this. The implications are dramatic.

Most likely, Wal-Mart will continue to automate. It must to survive. The question becomes, given its current dismal RPE, does the company somehow double its revenue to maintain the size of its current workforce. Or does, it accept current revenue trends and let 1 million people go.

It seems that Jack Ma is predicting the latter. This might very well be but one of many examples in decades of pain he predicts, an outcome that is the result analysis offered by the Brookings Institution and 7 out of 10 IT professionals. Or, who knows? Maybe the future is one in which the Wal-Marts of the world double revenue and manage to keep the human workforce intact.

As we have learned on the terrain, it's easy to predict the future when it involves describing the outcome of writing a check for $100 when you have only $10 in the checking account. Predicting the impact of automation on future human employment is a more complicated terrain to travel. But no matter what, there will be a future and most likely, it will be more automated. What will happen to the employees at Wal-Mart? I'll let you be the judge.

A SPECIAL THANKS TO YCHARTS.COM

YCharts.com provided access to the data and charting tools used herein, which were extremely helpful in the development of the ideas expressed which, by the way, are my own.

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AN UNANTICIPATED OBSTACLE TO FULL AUTOMATION

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I've been concerned about the impact of automation on human employment for a while. My research activity started after November 2016, when I decided I needed to learn whether the much-touted phrase, "We're bringing back the jobs," was valid or not.

While it is true that some jobs in the United States have been exported to other countries, a study coming out of Ball State University in Indiana asserts that 88 percent of the jobs lost by U.S. workers is due to automation. Combine this study with the one published in 2013 by Frey and Osborne out of Oxford University that says that 47 percent of the jobs in the United States are risk, then things don't look so rosy. Martin Ford, in his book, "Rise of the Robots," goes so far as to say that every occupation is at risk, not just low wage workers who are paid to do repetitive tasks that are easy to learn. Not only will we have machines flipping burgers, they'll also be perusing volumes of legal documents during discovery processes, which is the type of work that now is done by paralegals and newly hired law school graduates.

Machines are getting smarter all the time and they are getting cheaper. You can buy Baxter, a full fledged factory robot, for $22,000.

Baxter can work 24/7 and is not subject to OSHA laws or workers' compensation coverage.

Software? That's getting cheaper, too. Every day, another open-source project is made available on GitHub that allows anybody with a computer and connection to the internet to take advantage of the power of artificial intelligence and machine learning. You want Swift code for artificial intelligence? No problem. It's on GitHub and available to all for free! Want to convert your English ReadMe into Japanese? Simple, just use an API such as Microsoft Translator or Google Cloud Translate.

Given the current trends in technology, it's not hard to imagine that within the next 15 years to 20 years we're going to have a world in which fewer people are employed. This future scenario worries me.

About a week ago I was sharing my concerns with Chris Surdak at Surdak and Company. Chris works with large corporations implementing robotic process automation (RPA). He is also on the board of the Institute for Robotic Process Automation and Artificial Intelligence. Chris is at the front lines of using robotics and artificial intelligence to increase commercial efficiency. He and I share a concern about the wave of worker displacement we see on the employment horizon. However, Chris has an interesting take: While he agrees that automation is going to cause significant displace of human workers, he sees an obstacle.

Imagine you are an executive in a corporation and you have 5000 people under you. One day someone like me tells you that you can replace 80 percent of your workers, 4000 people, by streamlining your work processes using robotics and artificial intelligence. You should be ecstatic, right? That is a significant cost savings that is going to directly affect your bottom line.

But, it doesn't work that way because that is not how many corporate managers think. They want to keep their jobs and in order to do so they need two things: headcount and budget. So, if I come along and tell them that I can create an efficiency that is effectively going to cost them power (less employees and a smaller budget to manage) and maybe their jobs, do you think they are going to jump on board right away? Nope. In fact, they are going to do everything that can to slow down my work until they retire.

Chris's statement was a revelation to me. Previously, I thought corporations in their continual quest to seek greater profits will do whatever is required to reduce costs and increase efficiency. Most of us who do tech, particularly in DevOps, have embraced this notion. Automation is our friend. We're lazy. We want the code and machines to do the heavy lifting. And, we've created environment where automation is necessary, For example, large-scale container deployment alone went beyond the capabilities of human management a long time ago.

There is a good argument to be made that the factory floor has not had problems using machine automation to improve efficiency. Factories have looked for improved efficiency via tooling since before industrial textile mills used water wheels to power their looms. But, there are other industries that are risk-averse and slow to change; insurance, for instance. The virtue of an industry such as insurance is that it's ingrained in its culture to manage risk and to be measured when considering change. After all, would you want your retirement annuity to be subject to the whims of a day trader? No. You want your money well-protected by a cautious steward. However, with such safety comes inertia. Thus, there is an intrinsic resistance to change in general and automation in particular. Add in a culture of self preservation on the part of management and … well, you get the picture.

So there are industries that will be resistant—for a while, anyway. Then one of two things will happen. The companies that are not resistant to automation will enjoy the efficiencies the technologies bring. They will gain market share by providing a better product at lower cost and they will trample out the competition—think Uber and the taxi industry. Or, those resistant corporations will realize that to survive, managers who manage by "saving my job" will be given a golden parachute after revealing all the tribal knowledge hidden in their work groups. (Undocumented rules and processes are the bane of process engineers when implementing automation.) Either way, the march of automation will continue and workers will be displaced.

Given the increasing rate at which jobs are being replaced by automation, will these displaced workers find other jobs? This question I leave to you to answer.

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AUTOMATION'S IMPACT ON A STRUCTURED LIFE

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A few years back my sister's husband died after an unexpected illness. My sister, who was in her early 50s, experienced a devastating loss at a relatively early age. To her good fortune, my brother-in-law left behind an adequate pension and their mortgage had been paid off, so she didn't have to bear the burden of having to work to make ends meet. And she didn't—for a while, anyway.

After a period of mourning and adjustment, however, my sister decided to return to work. I asked her why, and this was her response: "There were only so many movies I could go to, only so many TV shows to watch, only so many trips to take. I just needed something to do."

Now you may ask, what does my sister's loss have to do with the impact of automation on human employment? Consider this: As automation replaces more human labor, fewer people will be required to make the economy function. Many of those whose labor is no longer needed will be left unemployed, sitting at home deprived of the thing that gave their lives meaning and structure: a job. And without a job, many will be left adrift—not just economically, but also psychologically, living a life without meaning or purpose. That

which made their lives worth living will be gone. The implications of a population put aside by automation and living a life without structure or meaning are significant.

Allow me to elaborate.

THE NEED FOR STRUCTURE IN DAY-TO-DAY LIVING

Human beings are not born with the instinct to organize their waking hours. Anybody who has a 2-year-old can tell you, a child will run around all day until he or she drops. It's up to mom or dad to say, "It's time for breakfast, "It's time for lunch," "It's time for a nap," "Bedtime's coming; put on your pajamas and let me read you a story. Good night."

Children need structure imposed on them from an external source. That's how it is. This role is filled by a parent, and later in life the school in the form of structured activities performed at usual times. By the time a youngster enters high school, most will have a firm sense of how a day is organized.

This sense of organization transfers well to the workplace: A good employee respects the structure of the day. She arrives on time, does the tasks for which she is responsible, communicates the status of her tasks, respects the time of others and meets the time demands made upon her. Whether you work in a factory or a law office, being able to operate effectively within the structure of the workday is essential to one's economic and psychological well-being. There is a certain comfort that comes from knowing where one is going to be on Tuesday and knowing what one will be doing.

So, what happens when the job goes away? How does one organize himself or herself without something explicit to do? As my sister said,

"There are only so many TV shows to watch."

Let's take a look at the extreme.

PROVIDING STRUCTURE WHERE NONE EXISTS

When I was a young man, before I got into programming, I was a counselor at a secure detention facility for adolescent boys. This a nice way of saying I was a guard in a kiddie jail. Most of my day was spent supervising the movement of teenagers who had committed very serious crimes. When I say supervising their movement, I mean that in the most literal sense. The job of my squad was to make sure the residents woke up on time, dressed in their rooms and were ready to go to school. Then, we called for lineup. The boys lined up and were counted. After count, our squad moved the line to breakfast and then onto the facility's school. Once in school, we stood at the back of the classrooms to supervise the residents. If a student acted out, we removed him from class. At the end of the school day, we did the lineup again and went back upstairs. The residents went to their rooms. Then they lined up for the exercise yard. At 6 p.m. we lined them up again and went to dinner. After dinner, we moved the line upstairs. At shower time, we moved the line to the shower room. The day was very structured, to say the least. Day in and day out, everyday was predictably the same.

And you know what? It worked.

The residents responded to the structure. Most grew to accept the routine. They went to school and got a little smarter. Three square meals a day made them a little healthier. These were boys who had been left to their own devices since early on, mostly because of neglect. They had little sense of how to organize a day. They just did whatever popped into their heads. And sometime what popped into their heads was an armed robbery or felonious assault. In terms of the ability to

organize themselves, most were at the level of a 2-year-old—a scared 2-year-old. Not surprisingly, the predictability of events and presence of supervision made them feel safe. Once, I asked one of the residents why he was there. He said with surprising candor, "Because I want to be."

WHEN A JOB GOES AWAY

Granted, adolescent incarceration is an extreme example of imposing structure on someone's life where no structure exists. But, what happens to a person when a job—the basic agent for organizing one's daily life—goes away?

Here's what happens.

Some people die prematurely. A study of Shell employees found that those who retire at 55 are 89 percent are more likely to die in the 10 years after retirement than those who retire at 65.

Others have increased rates of substance abuse. A study conducted by the Substance Abuse and Mental Health Services Administration indicates that 17 percent of unemployed worker suffer from substance abuse—twice that of those who are employed.

Or, they spend more time sleeping and watching TV, as reported by the *Wall Street Journal.*

Clearly, having a job is better than not having a job. Financial considerations aside, it's the way by which most people organize their day. As more people become displaced from the workforce because of automated labor and are living without the demands of daily work to structure a day, more of the population will feel adrift. If the trends described above stay true, there will be an increase in substance abuse, TV watching and death rates. They also may look to other external

forces for structure, such as political movements that promote order, rank and predictability.

So, what are we to do? In earlier versions of this article, I included a call to action to revamp, maybe even revert, the educational system to focus more on the arts and humanities rather than the baseline skills required to get a job. I planned to point out that artists, athletes, scientists and entrepreneurs don't need to a job to structure themselves. They always have something to do. They have an internal ability to organize themselves in the pursuit of short- and long-term goals that are their own. As we move toward full automation, these folks are going to do just fine.

Anyway, that's what I planned to propose in the earlier versions. Now I just don't know. I am not sure we have the social or political will to address the problems that are on the horizon. The highly educated people who have good analytics skills and a creative outlook will find paying employment. But, as trends indicate, those who are paid to follow instructions and perform redundant tasks will be replaced by robotic automation. They will go home. They will watch unlimited amounts of movies and TV on Netflix, Amazon and YouTube. They will play games on the internet, for a while anyway. Then, one day they will come to realize that there are only so many movies to watch and so many games to play. The appeal of an unstructured life will wane. They will want something to do and have no idea about how to make that something happen.

So the questions at hand are these: Will we fortunate ones—particularly those of us in IT, the people who are implementing the automation—watch from the sidelines? Or, will we come to understand the consequences of automation on human employment—and in doing so, will we be become part of the large-scale solution, devising

ways that help those that are going to be displaced think different and be different?

I hope so.

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THE IMPACT OF AUTOMATION: CONSIDERING 3 FACTS

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I've been interested in the ramification of automation on human employment for a while now. My profession, IT, is bringing more automation to the planet every day. I would be irresponsible to not understand the ramifications of my work.

Recently in my research I came across three facts that gave me pause. The facts are:

1. Due to improvements in automation, it takes fewer people to create more goods and services.

2. We are producing more good and services than we ever have, possibly more than we might ever need.

3. Just as it takes fewer people to create goods and services, fewer people are garnering more of the wealth being created.

The implications of these facts are dramatic and the implications are far-reaching. Allow me to elaborate.

FEWER PEOPLE CREATE MORE OUTPUT

Consider this fact: In 1790 90 percent of the people in the United States were engaged in agriculture. Most of the people fed the population. Two hundred years later, 2.9 percent of the population was engaged in agriculture. A relatively small amount of people create enough food for all.

Also, consider this one: In 1980 it took 26 people to create a $1 million in output. Today it takes 2.6.

The pattern is obvious. As time marches on, it takes a lot fewer people to create a lot more wealth. Why? Automation technology. Every year we create more hardware and software that does work previously done by humans. Automation never tires and produces as much as we want, when we want. The trend is strong and consistent. The rate of innovation is increasing. And as the rate increases, more people will be displaced by machines and software. I talked about this extensively in the first article I wrote in this series.

Let's move on.

WE'RE PRODUCING ALL WE WANT — AND THEN SOME

Today China, India, Brazil, Vietnam, Indonesia, Pakistan, Thailand, Mexico, Italy and Turkey combined produce 18.5 billion pair of shoes year. That's more shoes made a year then there are people on the planet. (The current population worldwide is 7.5 billion.)

Today there are 260 million cars registered in the United States, which comes out to a little more than one car for every adult in the population.

The number of cellphones in China in 2014 is 1.14 billion, in India there are 1 billion and in the United States there are 327 million. Just

about everybody in these countries has a cellphone. And the prices keep dropping. Eventually, everybody on the planet will have a cellphone—which, by the way, has more computing power than did the computers onboard an Apollo spacecraft.

Productivity no longer is constrained by the capacity of human labor to create goods. Whereas before the Industrial Revolution not enough goods were produced to satisfy consumer demand, today things are reversed. The modern struggle is finding enough buyers to purchase what's been made.

As I mentioned earlier, we're really good at making as much as stuff as we want, whenever we want. And yet, despite this abundance, there is a problem.

WEALTH IS CONCENTRATED TO A FEW

A report that came out earlier this year reveals a troubling fact: Eight people on Planet Earth own as much wealth as 50 percent of the rest of the global population. True, there is some dispute going on about the methods by which this number was determined. But, even if the number is 30 percent, the disparity in the distribution of wealth is astounding. More wealth is being concentrated to fewer people even as automation becomes more prevalent. Abject poverty may not be rising, but increased displacement of workers is. As workers become displaced, their wealth diminishes.

Saying "Things must change" is absurd. Things will change. The question is, "What will that change look like?" Will we have a fully automated society in which there are more than enough shoes to go around, or will we still have a world in which there are those that go shoeless?

WHAT DO WE DO NOW?

In previous articles I've talked about Universal Basic Income (UBI) as a possible way to address the problem of providing income for displaced workers. UBI is a viable solution, but not one that will to come to fruition in the near future. The problem is here today. So, what do we do?

Read on.

ECONOMIC SUSTAINABILITY OVER ECONOMIC GROWTH

I've mentioned many times, there is a good argument to be made that the jobs taken away by automation are not coming back, nor will there be an abundance of new jobs to replace those taken. My prior article supports my assertion. Eighty-eight percent of job displacement is due to automation. The need for human labor is diminishing at accelerated rates. That's the bad news. The good news is that automation has allowed us to grow our productivity more than we've imagined possible. But growth is not the answer. On a planet full of shoes, there are still those who go shoeless. The change we need to make is to move from an economy based on growth to one based on sustainability.

CHANGING THE WAY WE TALK ABOUT THINGS

I've come to accept that we cannot grow our way into economic prosperity any more than we can grow our way into good health. In fact, too much growth can kill you—just ask someone who suffers from morbid obesity. So I made the change in how I talk about prosperity. I no longer use the term "economic growth." Rather, I use the term "economic sustainability." I am a big believer that thinking follows language. Change the way we talk about something and we'll change the way we think about that thing. If we want to have a sustainable economy, we need to start talking that way.

CREATING WEALTH FOR ALL

Okay, I'll come clean. I think that given the current trends, too few have too much. More wealth parity is required. But, as we have learned on the terrain, overt wealth redistribution is not the answer. We cannot tell somebody we're going to take away a part of their wealth without upsetting them. But, we can set an example in the benefit of sharing the wealth to benefit all. We in IT have been doing it for years—it's called open source. We learned a few years back that when we give it away, we get it back. The trick now is to go beyond IT and make the open-source mindset part of our civic sensibility.

At some point in the not-too-distant future—say, about 20 years—we will be at almost total automation. If trends continue, there will be few with a lot and a lot with a little. People that don't have a lot don't have much to lose. Wealth inequality creates turmoil, unrest and overt aggression. If you think not, take a look at the excesses of France under Louis XIV which, by the time you got to Louis XVI, led to the French Revolution and the Reign of Terror. Or consider that the wealth disparity during the last generation of the house of Romanov led to the Russian Revolution. Nicholas dined in lavish halls while the serfs starved. Lenin prevailed.

Wealth parity creates political stability and political stability creates prosperity for all. Achieving wealth parity comes about by sharing. Again, we who have code on GitHub know this. Again, the trick is to make the open-source dynamic part of our civic sensibility.

Let me close by providing one more fact. One of the thing I've learned in my research is that as the population rises in a country, so does the GDP.

But, again the trend is that the wealth goes upward to a few. So we have a choice. As automation increases, we can learn to share the wealth and create a world that is stable, sustainable and prosperous. Or we can keep the current trend in place, allowing the few to have the most.

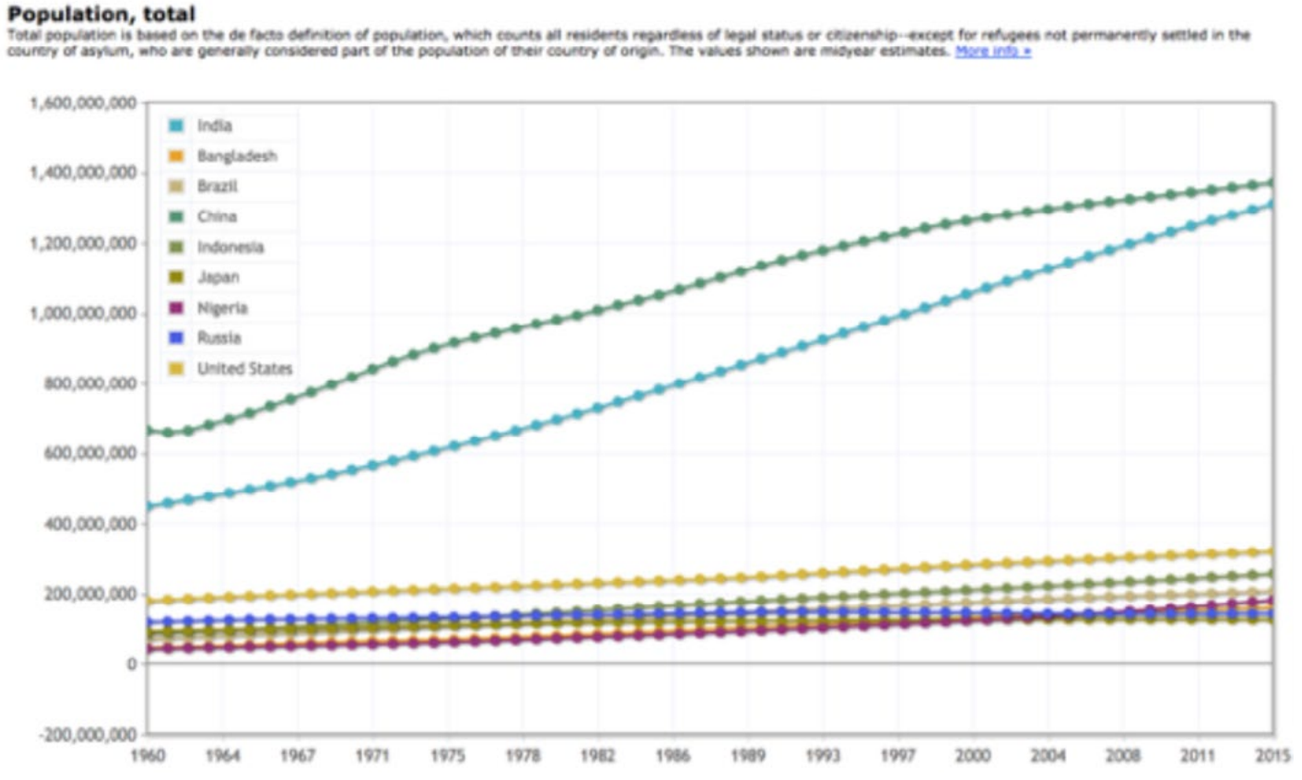

Figure 1: Population growth among 9 most populous countries, 1960 -2015 (Source World Bank)

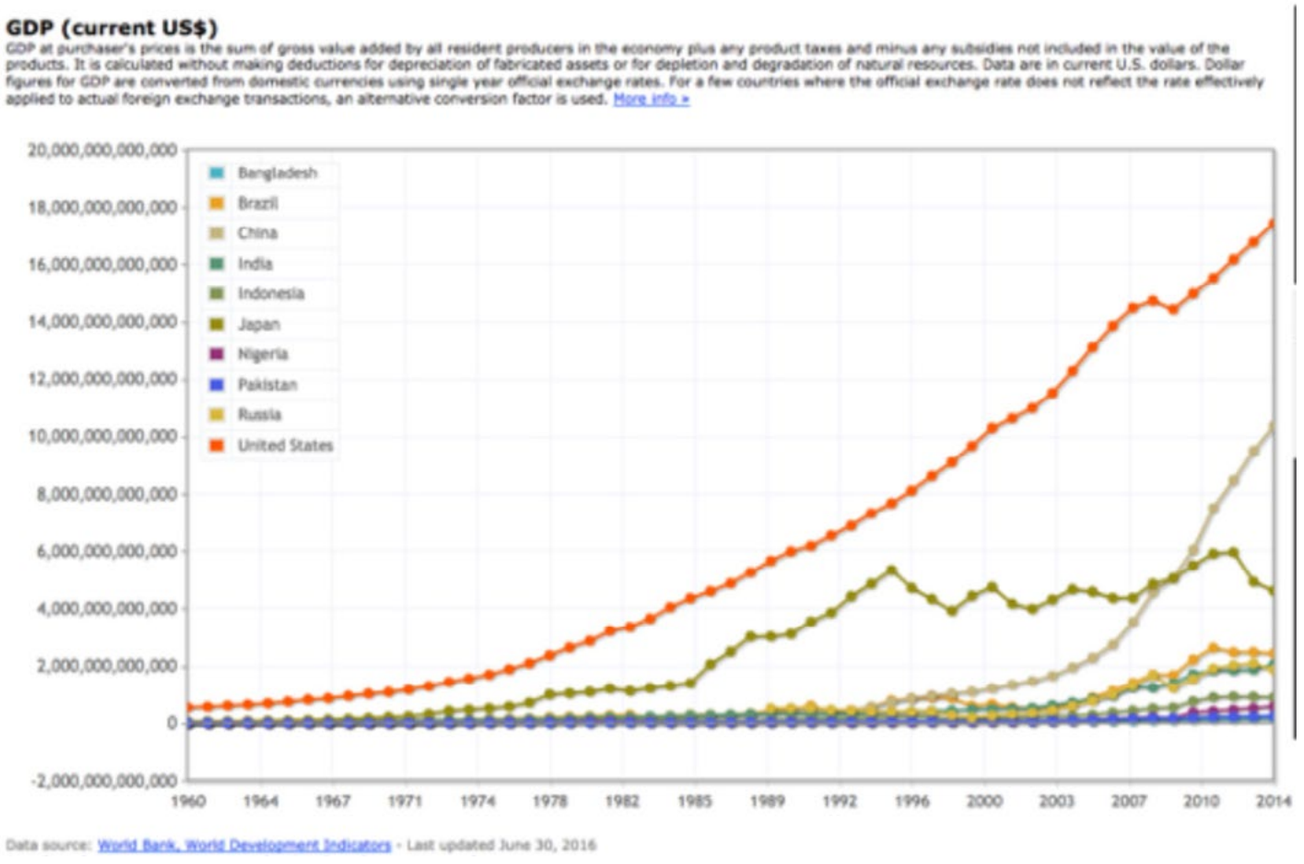

Figure 2: GDP Growth, 1960 -2014 (Source World Bank)

And because we don't need a lot of human labor to maintain the levels of production possible, rather than risk ongoing political upheaval and civil unrest, we can just get rid of those that unfortunately are on the wrong end of the distribution curve. Their labor is no longer needed.

Is such an idea vile and extreme? Yes, it is. Is it one without precedent? I'll let you be the judge.

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RETHINKING UNEMPLOYMENT IN THE AGE OF AUTOMATION

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In my last article concerning the impact of automation and robotics on human employment, I asserted that commercial job loss is more a result of automation than outsourcing. Also, I asserted that this trend was going to continue at an accelerated rate. I said we need to address three areas of concern to mitigate the impact:

- ***Income***
- ***Birthrate***
- ***The meaning of work***

In this installment, I am going to look at income—specifically, the need to rethink how we approach unemployment insurance.

Let me share a piece of personal information with you. A while back I lost a gig and was eligible for unemployment benefits. The amount I was eligible to receive back in 2012 was $300 a week. (Today, the maximum benefit is $450 a week for up to 26 weeks.) In the scheme of things that's not much money. In a major metropolitan area such as

Los Angeles, $1,200 a month does not even cover my housing costs. Luckily, I was able to get another gig in no time at all. But, I am a tech worker. Others are not so lucky.

Unemployment benefit in California is calculated by using the following formula:

highest quarterly earnings/25

Thus, the average programmer makes around $75,000 a year, which comes out to $18,750 a quarter. So doing the math:

$18,750/25 = $750 a week

But that **$750** number exceeds the maximum allowance. So, if you are a programmer who has been "let go" in California, the most you'll get is **$450**. Also, any benefit you receive is subject to income tax. If you find a part-time job to make up the difference, your benefit will be reduced.

The calculation is not special to California. Arkansas is pretty much the same. In Texas you get a little more.

If you are accustomed to making $75,000, which after taxes is about $1,100 a week, making ends meet on $450 pre-tax dollars is going to be a stretch.

This is not a pretty picture in a few ways. First, there is the built-in incentive to not work legally. You are not encouraged to use your creativity to launch your own business. Forfeiting earned money does not encourage you to take on small jobs that allow a company to get

to know you. (*Try and buy* has led to many a full-time position.) So what do you do? You go into the shadow economy. You work under the table: Have the check made out to your wife on her W9 or have it show up on Paypal as a gift. Is the practice shady? Yes. Is it necessary? Yep, particularly as the end of the month rolls around.

Now, if you are in a major city such as New York, San Francisco or Los Angeles and you are in prime employment age, between 25 and 45 years old, getting another tech job quickly is usually not a problem, provided you know what you are doing. But, what do you do if you are a 50-year-old Visual Basic programmer in Glen Falls, New York, with two kids still in high school and a housing market that is anemic? You just can't get up and move. And, learning programing technology is going to take time. Now, imagine the same scenario, only this time you work in a small furniture factory in Alabama and your job lathing table legs has just been replaced by a robotic CNC machine. The picture is now a nightmare.

So, what do we do?

I am a supporter of the notion of Universal Basic Income (UBI). UBI is a system in which citizens of a given nation are provided with enough basic income to meet the essentials of life. Typical in just about all the plans for UBI is the stipulation that there are no strings attached. Under UBI, if you want make more money you can. Your UBI allowance is not decreased. UBI can be more about developing your value in society rather than living off the dole.

Still, I am a realist. I am not of the belief that one day a magic wand will be waved over state and the national capitals, that politicians will come to their senses and amazingly we will have UBI. Big change does not work that way unless something gets blown up (Think Pearl Harbor

and 9/11). I am of the thinking that when it comes to large-scale change, the best thing to do is focus on one thing. For me, that one thing is to eliminate the "payback" clause in unemployment benefit policy.

Given that many, if not most, jobs will be automated before the end of the century, the notion that unemployment is a benefit that tides us over until the next job comes along is outdated. There might not be any next job. Rather, unemployment might be a time to reinvent ourselves. Reinvention means using the unemployment benefit as a baseline of income upon which we can build more income. We should not be penalized for making money on top of the unemployment benefit. Rather, the benefit needs to be a subsidy from which greater income grows. Once a livable level of income is achieved and a trajectory of reliable, personal revenue is established, we can revisit the size and limit of the benefit allowance. Until that time, the allowance remains in place.

Think of eliminating the "payback" clause as training wheels for full UBI. Removing the ""payback" clause in unemployment benefit policy is a concrete first step to having realistic policies about labor and income in the Age of Full Automation. The legislative debate and public education that will happen in the course of eliminating the "payback" clause of unemployment insurance will put Universal Basic Income on the social and political agenda.

UBI is not the stuff of fantasy. It already has an experimental implementation in Finland. The National Digital Council of France recommends testing UBI. UBI exists in a modest way in the United States in the form of the Alaska Permanent Fund.

As I mentioned in the previous article, using automation to replace human labor is nothing new. But, what is new is the rate at which the human labor is being replaced. If we do not start implementing

concrete ways to address the long-term ramifications that result from the ongoing elimination of human labor from the commercial landscape, the storming of the Bastille in 1789, the bread riots of 1863 in the southern United States and the removal of the Bonus Army from Washington, D.C., in 1932 will look like a warmup act for what might very well transpire. Removing the "payback" clause from current unemployment benefit policy is but a small step toward addressing the issue at hand. However, put a lot of small, achievable steps together and after a while you've made significant progress solving a big problem.

So here is something we can do.

Take 15 minutes out of your day to copy the following and send it to your local and state representatives as well as your representative in Congress:

Dear Representative _____

Please initiate legislation immediately to remove the practice of deducting money earned while receiving unemployment benefits from a recipient's payment. Also, make it so that unemployment benefits are no longer taxable income.

As automated labor continues to do more jobs formerly done by humans, unemployment insurance benefits need to be adjusted in favor of empowering unemployed workers to participate in the modern economy, not penalizing them for using any and all available resources to improve their condition.

Thank you,

YOUR NAME HERE

The problem of automation replacing human employment is real and it's not going away. The 15 minutes you spend will be well worth the time invested.

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WHAT DO WE DO WHEN EVERYTHING IS AUTOMATED?

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Recently, I came across a study the caused me to think beyond the day-to-day world of code-slinging in which I live. According to the study conducted by Center for Business and Economic Research at Ball State University in Indiana:

"Almost 88 percent of job losses in manufacturing in recent years can be attributable to productivity growth, and the long-term changes to manufacturing employment are mostly linked to the productivity of American factories."

Just translate the term "productivity of American factories" into the word "automation" and you get the picture. Other workers are not taking jobs away from the gainfully employed, machines are.

This is not a new trend. It's been going on since before Eli Whitney invented the cotton gin. Industry creates machines that do the work of humans faster, cheaper, with more accuracy and with less failure. That's the nature of industry; nothing new here. However, what is new is the rate by which the displacement of human beings from the workforce is happening.

The Bureau of Labor statistics projects that by 2024 the U.S. economy will need 50 percent less car mechanics, 42 percent less telephone operators, 26 percent less postal clerks and 20 percent less parking enforcement officers. Or, to put it another way, cars will be better at self-repair, call routing technology will get better at conducting verbal conversations with humans, self-service postal machines will get better at taking care of human transactions in the post office and parking meters will know how to write tickets.

Here's another another point to ponder. As the quality and reliability of self-driving vehicles improve, it's not far-fetched to imagine self-driving trucks becoming the norm on the nation's highways. How many truck drivers will be displaced once self-driving trucks are everywhere?

Also, think about this: As Uber and Lyft mature in the business landscape and self-driving cars become commonplace, the ride-share companies will replace human driven vehicles with self-driving vehicles. Then, Uber or Lyft will start to offer a pricing model that is flat fee for 24/7 service with unlimited mileage. So, to keep it personal, imagine Uber/Lyft offering me a deal in which I pay $150 a month to have all my driving needs taken care of. Or, I can continue to pay the $400 it costs me for my car lease and insurance coverage (yes, I lease a modest vehicle). Which way do you think I will go? Spend $400 for the pain of driving in a car in LA traffic or spend $150 to get where I need to go while I read a book in the back seat? Me? I'd fork the car over in a New York minute.

As if this isn't startling enough, try this one out: Walk down your street. See all those cars parked on the side of the road. In the near future, using the Uber/Lyft automation scenario, they won't be there any longer. Any car made will be used 24/7. All this translates into less

cars doing more work. And less demand for cars means less cars being made. Less cars being made means less people working making cars. You get the picture.

What about software? Let's take a scenario that is part of my day-to-day coding world, logging. In the old days, you'd log to a file on disk. Over time, that log file got so large that a human would need to move the file manually onto an archive disk so as to not eat production space. Somebody comes along and says, "Hey, I can write a piece of code that watches the size of the log file and moves it automatically when the file gets too big." So much for the person doing the manual file move. But, still, you had to keep adding capacity to the archive machine, which typically meant a human walking down to the server room and twiddling with some hardware. Then someone has a great idea, "Let's use this thing called cloud storage as a back-end for a log collection service. We'll leverage the elastic capacity features of cloud storage and write out logs to that service. Hell, why make a service? We'll subscribe to an existing one and save the development costs." Thus, no more humans needed to monitor capacity, move files, write incidental scripts—any of it. In terms of logging, a bunch of automation is doing the work a lot of humans used to do. Is this progress? Might be. But the trend is unmistakable, so much so that I have no problem imagining a future in which 90 percent of work that used to be done by humans is done by low-cost, automated, robotic, labor.

We've always been on our way to automating everything. The only difference between then and now is that now we are really, really close to full automation. Asking the question, "What will we do when everything is automated?" is no longer fantastic, it's essential.

So what will we do?

“Simple,” you say. “We’ll retrain the displaced workers.” Really? Many of us in the software game know that the notion of retraining is a joke. If you are not constantly learning the new stuff, you are out of work. For a knowledge worker, continuous learning is an ongoing requirement for commercial viability. And, the baseline from which you are learning is very high. In other words, you need to know a lot to get the basics of how to write a deployment script in Ansible that runs against AWS. And, even as you are learning that basic technique, somebody is already creating a technology that will make the technique you are learning obsolete.

So back to the question, what do we do?

First, let’s do the obvious. When near total automation has the result that there is no longer any work for most humans to do, we need to come up with other means of survival. Survival in the modern world means having money to live on. Charles Murray suggests in the Wall Street Journal that we plan to implement Universal Basic Income. Finland is starting a pilot project based on the idea. Other countries are experimenting too. Universal Basic Income is a program in which citizens of a state are provided with a base income on which to live. Some programs vary basic income according to income produced otherwise. The common thread is an understanding that jobs are not plentiful and that depending on one for survival is not realistic.

The notion of Universal Basic Income is not that new. It’s been around since the 1960’s, proposed by folks such as Milton Friedman as the negative income tax.

Second, we need to address the elephant in the living room: the birth rate. In the old days when agriculture and small, private farming was a major industry in the United States, having a large family made sense.

You needed your family members to work the land. As the Industrial Revolution created demand for factory workers regardless of age, large families still made economic sense. But now the trend is that we need less people to do more. Thus, having large families becomes counterproductive to the economy overall. Yes, there are certain sensibilities out there that encourage large families and adherents to such thinking have large families as a matter of choice. Still, many families end up with large families for reasons other than intention. It just sorta happens.

Thus, to ensure that humans have a chance at a viable existence in a fully automated world, implementing effective family planning policy and practice becomes as useful to the society of the near future as the anti-smoking efforts that started in the 1960s does today. I am not advocating draconian, government mandated family planning. We cannot legislate family size anymore than we could legislate smoking behavior. Rather, we need to create a social condition in which the wisdom of the idea prevails.

Finally, we need to address the need for human dignity in a fully automated world. For better or worse, we need to accept that in the near future the traditional relationships between demand, productivity and income no longer may be applicable. The old days of human workers making stuff and getting paid for their product or labor are coming to an end. Yet, one of the intangible benefits of the old days was the dignity and satisfaction that went with pulling your weight and earning your keep. Being able to provide for yourself and your family defined your worth in your own eyes as well as those around you. This need for dignity will remain no matter how the technical and economic landscapes evolve.

When I started doing the research for this piece, I asked others

in the know to respond to the prospect of a world that is fully automated. One the people I talked to was Phillipe Kahn, founder of Borland, Starfish Software, LightSurf Technologies and most recently, Fullpower Technologies. Here is his response:

"I remember being in India and watching a construction site: Lots of people, elephants, activity. I asked, 'Why don't you all use bulldozers and tractors and prefabricated concrete parts?' The answer was enlightening: 'How would this community make a living with dignity?' That's the whole paradox that we are dealing with: Productivity versus dignity for communities that could be unemployed for generations."

There is a difference between work and labor. Work is an activity a human does to give one's life meaning. Labor is what a human does to survive. In the old days work was your avocation, labor was your vocation. Some humans were fortunate enough to have their activities be both avocation and vocation. Others went to work in factories, farms and offices to earn a buck. They pursued other interests at other times. But whether you sang in the New York City Opera full time or in the choir on Sunday morning, the dignity of your work, bringing music to the ears of other humans, was in full force.

So, the final part of answering the question, "What do we do when we've automated everything?" is this: Preserve the dignity of the person and the community. A fully automated world will be a wealthy world unless we blow it up. Productivity produces wealth. That's the way it is. Regardless of who is or what is the owner of the wealth—government, corporation or private citizen—sharing will become more important than ever. Concretely, this means allocating a significant amount of money to people and organizations that do work that has little or no commercial value, but extraordinary amounts of human value. When it comes to commercial value, the machines will have

that end of the economy covered and then some. However, stuff that has little commercial value—curing low occurrence diseases, space exploration, academic research, expanding the arts—this is where human activity can excel.

In the old days we had a notion called the commonwealth, that shared space where our individual assets grew. We shared some to get some. In the automated future it might have another name. But no matter the name, it will be a place where humans work with dignity in communities and most labor is the left to automated robotics. If not, the common thread of our individual survival might indeed be nothing more than alms for the poor while automation creates wealth for a few.

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