

## **Technology and Global Societal Evolution**

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## **RESEARCH METHODOLOGY & INTRODUCTION**

Over the course of six months we have researched how the rapid evolution of technology will impact global society. Our research, both primary (original research surveys and one-on-one interviews) and secondary, has been conducted across the United States, Hong Kong, South Korea, and Japan from January 2019 to June 2019.

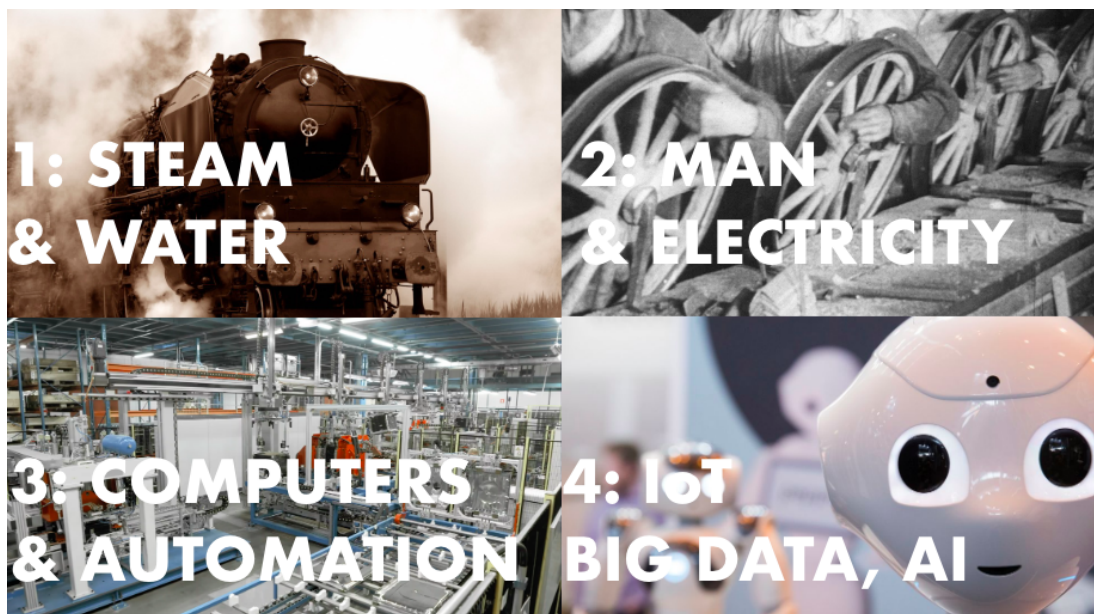
Our research journey began with defining six key areas that support the prosperity of society and how each is impacted by technology. These areas are: **access, data, welfare, labor, ecosystem, and regulation**. We uncovered that societal transformation starts with **access** to technology and that segregation and barriers within local communities, legislation, regulation, and economic limitations create nuances within regions. The Internet has granted people greater access to information with significantly more diverse range of educational sources that have little to no barriers. Yet, with this increased access comes increased expectation. We observed an increased emergence of **data** and how to drive value through data monetization and how digitized consumer information is an asset that can be sold and exchanged. We identified that the healthcare and agricultural industries have become the leaders to leverage technology for better efficiencies creating **welfare** for society. In terms of **labor**, we found that as technology continues to replace tasks that once required educated skills, “soft skills” are moving to the forefront of our future labor workforce. Soft skills such as creativity and emotional intelligence, are the areas least likely to be automated and become the highest in demand in the future. We recognized the damaging impact of mass consumption on our global **ecosystem** and foresee that advancements in technology have the potential to save our planet. Opposition of technology continues to rapidly grow due to fear and the lack of education. As a result, there is a new global counter-culture to disengage from technology. Societal groups are becoming more resentful and have even gone to the extreme of rejecting technology, opting out from usage, and demanding clearer privacy **regulations**.

After uncovering layers of information regarding these six areas of society that are directly impacted by technology, we began fielding our primary research. Using the Survey Monkey platform, we surveyed over 1,000 people across the United States to better understand their knowledge of technological advancements and their direct impact on society. Through our surveys and additional secondary research, we have learned that we are at the cusp of the Fifth Industrial Revolution, where a fusion of technologies and the merging of spheres between the physical, digital,

and biological are occurring. The Fifth Industrial Revolution is being triggered by the rapid growth of blockchain, artificial general intelligence (AGI), and more fluid hardware processing capabilities of quantum computing. The thesis of this paper is as follows:

*As our present day society is shaped by the advancements in technology, we cannot ignore its profound effects on our everyday lives and society as a whole. The technological achievements of today are only a foreshadowing of what is to come. It is undeniable that the Fifth Industrial Revolution, fueled by advancements in quantum computing, will be accelerated by technology at unprecedented speeds. The need to be informed and actively aware of the potential of technology's power will require active education, collaboration and regulation for society to progress into a sustainable future.*

The new era is the Fifth Industrial Revolution. The first three Industrial Revolutions focused on physical advancements including steam, electricity and personal computers. The Fourth Revolution centered on both the physical and the digital, giving way to technologies such as the Internet of things (IoT) and AI. In this paper, we define the Fifth Revolution will be powered by the most advanced technology yet, that will bring society closer to a point in time referred to as Technological Singularity.



In our paper, we take an in-depth look at technology as we approach the Fifth Industrial Revolution in the year 2040, through the lenses of data, welfare, and the environment. Technology is defined as "the application of scientific knowledge for practical purposes, especially in industry. The

origin of this word is from the early 17th century: from Greek tekhnologia ‘systematic treatment’, from tekhnē ‘art, craft’ + -logia see -logy (Oxford Dictionaries). From the “Stone Age. Bronze age. Iron age. We define entire eras of humanity by the technology they use” (Read Hastings, CEO Netflix). Many people believe that the start date of the 1990s technology boom occurred on August, 9th, 1995, the date that Netscape held its initial public offering, and signified the beginning of the Fourth Industrial Revolution. From 1995 until today, there has been exponential growth of technological innovations that have impacted billions of people. Some of these advancements identified by many tech news publishers were, “personal computers (PCs), palm pilots, hybrid cars, AOL dial up Internet for \$19.95 USD a month, the iPod, the iPad, Kindle, lightweight laptops, the iPhone and the Samsung Galaxy” (Dee). Currently, technology is stimulating a merge of spheres between the physical, digital, and biological across the continents of our earth. Excitement about the impact that technology will have on our future exists in-tandem with fear of extreme growth and what the “tech-unknown” entails.

This paper addresses how technological advancements in 2040 will impact society, and how society can prepare for this new industrial revolution. Innovations in cyber computing through quantum mechanics will impact our welfare. We also explain how data-capture will transcend to more than what we do on our devices. We offer predictions for labor, education, and global communication, regulation; and how we can control waste and produce clean energy through the use of technology and new standards of living. We define the need for active awareness through global regulation and education regarding technology’s power. A rapid increase in connectivity and its direct impact on data, welfare, and the environment have specific implications for the global Beauty Industry. Due to this, we provide insight and actionable steps to bring the Beauty Industry into the tech forefront and into the future. “We see the future not as something out of our control, but for something that we can shape for the better” (Barack Obama, Former U.S. President).

## **TECH & DATA**

We are in the age of data, and at a major tipping point, where all industries of the world will need to evolve as fast as our data evolves, or they will not survive. Modern technology enables us to obtain an enormous amount of information and instantly connect us on a global scale. The 2018 Global Digital suite of reports from *We Are Social* and *Hootsuite* reveals that there are currently more than four billion people around the world using the Internet. This equates to over half the

world's population being currently online. The latest data shows that nearly a quarter of a billion new users started using the Internet in 2017. Africa has seen the fastest growth rates, with the number of Internet users across the continent increasing by more than 20 percent year-on-year. Most of the growth in Internet users has been driven by the increase of affordable smartphones and mobile data plans. More than 200 million people got their first mobile device in 2017, and two-thirds of the world's 7.6 billion citizens now have a mobile phone (Kemp, 2018). Globally, we are becoming more connected than ever before, and at an exponential speed. By 2040, access to technology will be at an all-time high. QuantumRun, a research and consulting agency that uses long-term strategic forecasting to help organizations thrive from future trends, forecasts the world's population to increase by 17 percent to reach over nine billion people, and the average number of connected devices per person increasing by 138 percent, with each person possessing nineteen connected devices. QuantumRun has also predicted, the global number of Internet connected devices is expected to reach 172 billion and global mobile web traffic to equal 644 exabytes by 2040. Today the Internet is wired into our everyday lives to assist in our daily tasks from ordering food in our home, driving our cars, and essentially playing the role of our virtual personal assistants. We have already experienced how the Internet of Things (IoT) has begun to converge and the items we carry such as wallets, credit cards, phones, car keys, and ID will no longer exist as separate entities in the near future (Cave, 2015). The rapid rise in the use of the Internet, powered by the significant increase in the number of owned smart devices, has provided convenience to the people of today but does society truly understand the nature and extent to which convenience comes with a cost? The harsh reality is, today's cost for convenience is the collection and monetization of personal data.

### **Data Is The New Oil**

Historically, oil has been the world's most valuable resource. According to *The Economist*, it was the key functionality of everything from the government, to local companies for many centuries. Fast forward to the 21st Century, data is the oil of the digital era (Economist, 2017). From our research it is evident that data has become an essential resource that powers the information economy, and when extracted, reveals valuable insights and opportunities. It is our contention that the importance and power that data possess will grow tremendously stronger and will become the first common global language. This increased significance of data in our everyday lives will transform organizations and societies.

The amount of data produced every day on a global level is enormous. There are 2.5 quintillion bytes of data created each day at the current pace. From 2016 to 2018, 90 percent of the data in the world was generated (Marr, 2018). Data is a tool that has an impact on every industry. Today, there is an obvious emergence of data, and how to drive value through data monetization. Digitized consumer information is an asset that can be sold and exchanged. With the growing amount of data, Big Data has become a buzz word in the last five years, and a concept in technology that is defined by an accumulation of data that is too large and complex to be managed by standard database management tools (Merriam-Webster, 2019). According to McKinsey Global Institute, Big Data can generate an additional \$3 trillion in value every year globally; out of this, \$1.3 trillion would benefit the United States. The same report also estimated that over half of this value would help consumers in several different ways, such as, “fewer traffic jams [and] easier price comparisons.” It is interesting to note, that these benefits may not necessarily present themselves as impacting Gross Domestic Product (GDP), but rather improving quality of life. Other examples of how data is driving the economy include new innovations such as Nest home thermometer, mass-customized shoes, business process optimization, targeted marketing that utilizes customer feedback into product design, better organizational management and faster innovation through a shorter research and development cycle. According to a study conducted by Erik Brynjolfsson of MIT, companies who are currently adopting “data-driven decision making achieve five to six percent higher productivity and output growth than their peers, even after controlling for other investments and the use of information technology.” Comparable differences were discovered in asset utilization, return on equity, and market value (Kennedy, 2019).

Companies recognize data’s immense value and many are making big investments to ensure they are rightfully equipped for the next evolution of data. Big Tech, consisting of key tech industry leaders, had a record year of capital spending in 2018. Google-parent Alphabet saw its capital bill surge 91 percent from the year before to \$25.1 billion, making Alphabet the largest spender in the S&P 500, even outranking asset-heavy businesses like oil giant Exxon Mobil. For Google and its big tech counterparts, most of this spending is invested into highly advanced data centers used to power their services. It's an expensive endeavor. Combined capital spending by Google, Amazon.com, Microsoft, and Facebook totaled \$77.7 billion in 2018; which was more than the \$71.5 billion spent by the world's four largest oil companies. Michael Nathanson, a Senior Research Analyst at MoffettNathanson, projects Google's capital spending on data centers alone, excluding real-estate

investments to increase another 30 percent in 2019 (Gallagher, 2019). As Big Tech companies are growing exponentially, they are expanding into new cities. In February of 2019, Google announced they will build new data centers in Nevada, Texas, Oklahoma, Nebraska, Ohio, South Carolina, and Virginia. With this new investment, Google will now have a home in 24 total states, including data centers in 13 communities. These large investments into data centers and office spaces will encourage growth and investments in local communities and the creation of thousands of jobs, while improving the products and services that help billions of people and businesses globally. These additional investments will provide faster and more reliable services for all users (Lardinois, 2019). Data has brought significant value to organizations across many industries, and we should not ignore its potential. Instead, we need to educate, embrace, and leverage its power to improve how society functions holistically.

### **Data and Commerce**

An explosion of consumer data has enabled companies and brands to more easily engage in one-to-one meaningful relationships by offering tailored experiences and recommendations to consumers. As consumers are using a variety of devices and interfaces to connect to the internet, companies have been forced to change the way they conduct commerce. This always-on connectivity provides new levels of convenience, simplicity, and knowledge. It also generates an abundance of consumer data that provides insights to behavioral patterns, preferences and consumption, which has become a valuable asset; so valuable it can be sold or traded for monetization. Today, brands no longer control information about their products and services. Instead, informed consumers walk into commerce transactions armed with information about what they want and what they should expect to pay. As technology continues to advance at rapid speeds, it will further redefine what it means to shop for consumers in 2040. It is our supposition that retailers of the future will create an equilibrium between leveraging technology to remove the hassle of shopping for mundane purchases, while tapping into the innate curiosity to see, feel, and experience specific products. According to a 2019 Forbes' article, technology advancements that will emerge by 2040 will create immense competition in the retail landscape. Examples of these advancements include retailers that will have the ability to send more contextual alerts to notify of new pricing, products or experiences to a consumer's individual wearable or voice platform. This will provide the consumer with instantaneous and meaningful updates while enabling retailers to make an instant connection with



the consumer as soon as they enter the environment, rather than waiting until they checkout and pay for their goods. The data collected from this tool will also allow for retailers to obtain a more accurate understanding of each store's foot traffic and their consumer's shopping behaviors. Retailers will also utilize facial-scanning to identify consumers upon entry to the retail store, thus enabling them to provide a more tailored in-store experience for each consumer. Payment for products or experiences will be automatically made upon exit from the retail store and stores will have separate entrances for those picking up orders made online. Shopping in 2040 will become more contextual, allowing consumers to try on the clothes or beauty products in a virtual representation of the final environment where it will be worn, such as cold zones to try on winter coats and turf to try on cleats. Virtual personal stylists will become the norm and consumers will look to them to make the best choices in the context of what the individual already owns or what might complete a desired look (Evans, 2018).

As retailers obtain more data to better their consumer experience with the brand, many consumers fear privacy issues and have safety concerns that surface as negative sentiments for consumption. According to the New Topography of Retail study by Oracle, 56 percent of global shoppers still want personalized offers. However, only 20 percent of consumers feel offers are always personalized to them. As a large number of consumers already do not see the justified value in sharing their data to get personalized offers on a general scale, they are becoming increasingly opposed to having companies collect and hold their data with some consumers even boycotting purchases from certain retailers. Consumers do not want their data collected and saved. "One of the most startling data points is that 86 percent of global consumers would exercise the right to be forgotten," said Mike Webster, SVP and General Manager of Oracle Retail in an interview with Retail TouchPoints. However, we discovered people are willing to share their personal data if they know and understand how it is being used. For the FIT Proprietary Technology & Society Survey, survey participants were presented with a list of nine hypothetical future inventions that would have a positive impact on the health, welfare, access, and the ecosystem. They were asked to select all of the ideas for which they would be willing to allow companies to have access to their personal data in order to develop these inventions. 60 percent said they would be willing to give up their personal data for a device that can cure cancer, while 53 percent said they would be willing to give up their personal data for a machine that can clean the atmosphere of carbon emissions. Only 10 percent of respondents said they would not give up their personal data for any of the options. This indicates that

people are willing to share their data under the right context and circumstance. Businesses of the future, will need to be transparent while clearly communicating, what data is being collected and how it will be used, if they want to continue to build strong relationships with their consumers.

### **Data Privacy and Security**

Our current society craves more advanced technology, and from a quick glance many are unbothered with the current rate it is advancing. In the FIT Proprietary Technology & Society Survey, we uncovered that 56 percent of participants are comfortable with the current rate that technology is evolving today, and prefer this rapid rate of tech evolution. We surveyed the same participants and asked how the use of technology in their day-to-day life makes them feel. For many, technology brought positivity to their lives. 63 percent of people said that their use of technology in their day-to-day life makes them feel happy. The top three sentiments selected were happy, excited, and in control. Technology advancements such as smartphones and virtual assistants (e.g. Amazon Echo or Google Home) provide convenience and have reorganized our lives for easier, faster, and more impersonal ways of doing almost anything. However, society is conflicted. Despite 39 percent of people feeling in-control of technology, 92 percent said they feel there is a need for laws regulating the sharing of personal data.

As much as information technology has become important to our lives, it is facing serious ethical challenges. These challenges include a lack of privacy, security, copyright infringements, and increased computer related crimes. Giving away information data for increased conveniences also results in the loss of privacy and control. According to FleishmanHillard, 80 percent of consumers rate data security and protection as, “very important.” Data utilized by external parties to optimize services and products is happening. Recent scandals and cases such as Facebook and Cambridge Analytica have shined a light on the magnitude of destruction that can be caused due to a data breach. Ultimately, a breach jeopardizes society’s personal security by putting personal and private information at risk, with the potential to be used in a harmful way. In this specific case, Facebook exposed data on up to 87 million users to a researcher who worked at Cambridge Analytica, which worked for the Trump campaign. There are strong beliefs, this breach of data impacted the 2016 U.S. Presidential election outcomes due to the illegally obtained information used to target individual American citizens in regards to the campaign. It is our contention that companies take the following into consideration to prevent their consumers from becoming a victim of a data breach: 1) is the

platform secure and trustworthy enough to protect an attack or breach; and 2) is the privacy disclaimer and agreement clear enough to the end user, as it relates to the type of information it releases to third party partners. Data sharing deals between large technology companies have been more publicized and people are now more aware of how this impacts their lives.

The fear of data privacy is not just on a personal scale of security, but impacts economies as a whole. Since information technology greatly aids the speed, flow, and access of information, cyber crime has become an ever rising profession. Criminals have been eagerly utilizing loopholes that technology offers. Many businesses and organizations are at risk of becoming a cyber victim on a daily basis, as most, if not all business are based on a digital network. According to Visshal Marria on cyber security for Forbes.com, digital transactions are easily tracked and recorded, raising concerns about surveillance and those who can access the data. Businesses that host other companies' data on their server or manage clients' IT systems remotely make super-tempting targets for hackers. By breaching these companies' systems, they can get access to those of clients, too. Big cloud companies like Amazon and Google can afford to invest heavily in cybersecurity defenses and pay salaries that attract some of the best talent in the field. That doesn't make them immune to a breach, but it's more likely that hackers will target smaller firms. Attacking from the computing cloud already has started to happen. The U.S. government recently accused Chinese hackers of sneaking into the systems of a company that managed IT for other firms. Using this access, the hackers were allegedly able to gain access to the computers of 45 companies around the world, in industries from aviation to oil, and gas exploration. Dubbed "Cloudhopper" by security experts, the attack is just the tip of what's going to be a fast-growing iceberg. "You're going to see hackers move from focusing on desktop malware to data-center malware" that offers significant economies of scale, says Chenxi Wang, the founder of Rain Capital, a venture capital firm that specializes in cybersecurity. When it comes to cybersecurity, the companies best prepared to tackle tomorrow's threats will be the ones most willing to exercise their imaginations today (Giles, 2019).

As society embraces technology advancements and seeks ways to improve people's lives, there is still a significant concern relying entirely on a digital system. Sweden is one of the first countries in the world that is making advancements to become a cashless society. According to The Guardian, a well-recognized financial authority, Sweden has been advised to request banks to continue printing notes and producing coins until the government can be certain of the sustainability and safety of a digital, cashless system. Swedish lawmakers are also assessing the potential failures

of online payments and bank accounts in the case of the occurrence of power failures, hackers, or cyber war. Modern technologies built around banks' old, existing infrastructures are risky as established banks' IT systems date back to the 1970s. Moving payments is associated with increased risk of crimes such as identity theft, account takeover, fraudulent transactions and data breaches, which overexposes the average user. "When you are where we are, it would be wrong to sit back with our arms crossed, doing nothing, and then just take note of the fact that cash has disappeared," said Stefan Ingves, the governor of Sweden's central bank, known as the Riksbank.

Our global governments feel the pressure from society in regards to the absence of data regulation. Laws are slowly being put in place to regulate data such as Europe's General Data Protection Regulation (GDPR) and most recently in the U.S., the California Consumer Privacy Act. Both laws enforce that companies must inform all consumers of what personal data is being collected, how it is used, and if it is being sold or disclosed to a third party; while also providing the consumer the option to delete their personal information. These recent laws have changed the worldwide conversation around privacy and consumer protection, but it is just the start. As the amount of consumer data increases, so do the chances of readily-available data falling into the wrong hands. Companies and businesses within society need to make data privacy and protection a number one priority to ensure the safety of people's personal information which will result in a stronger level of trust between companies and their consumers.

### **Data and The New Threat**

New threats will emerge that we will need to pay close attention to. According to a recent article from MIT Technology Review: as technology advances, there will be a greater emergence of cyber threats. Mega-breaches and ransomware attacks, such as threats to web-connected consumer devices and critical infrastructure such as electrical systems and transport systems will continue to be top priority for security teams. However, the exploitation of AI-generated fake video and audio will become a concern. Thanks to advances in AI, it's now possible to create fake video and audio messages that are incredibly difficult to distinguish from the real thing. These "deepfakes" could be a boon to hackers in a couple of ways. AI-generated "phishing" emails that aim to trick people into handing over passwords and other sensitive data have already been shown to be more effective than ones generated by humans. Now hackers will be able to throw highly realistic fake video and audio into the mix, either to reinforce instructions in a phishing e-mail or as a standalone tactic.

Cybercriminals could also use the technology to manipulate stock prices by, say, posting a fake video of a CEO announcing that a company is facing a financing problem or some other crisis. There's also the danger that "deepfakes" could be used to spread false news in elections and to stoke geopolitical tensions. In the past, this type of criminal invasion would have required the resources of a big movie studio, but now they can be pulled off by anyone with a decent computer and a powerful graphics card. Startups are developing technology to detect "deepfakes", but it's unclear how effective their efforts will be. In the meantime, the only real line of defense is security awareness training to sensitize people to the risk (Giles, 2019).

As AI gains popularity and more industries utilize AI, there is a threat of possible poisoning of AI defenses. Security companies have rushed to embrace AI models as a way to help anticipate and detect cyber attacks. However, sophisticated hackers could try to corrupt these defenses. "AI can help us parse signals from noise," says Nate Fick, CEO of the security firm Endgame, but, "in the hands of the wrong people," it's also AI that's going to generate the most sophisticated attacks. Generative adversarial networks, or GANs, which pitch two neural networks against one another, can be used to identify what algorithms defenders are using in their AI models. Another risk is that hackers will target datasets used to train models and poison them. An example of this would be switching labels on samples of malicious code to indicate that they are safer than suspected (Giles, 2019).

Smart contracts are susceptible to hacking as well. Smart contracts are software programs stored on a blockchain that automatically execute some form of digital asset exchange if conditions encoded in them are met. Entrepreneurs are pitching their use for everything from money transfers to intellectual-property protection. But it's still early in their development, and researchers are finding bugs in some of them. So are hackers, who have exploited flaws to steal millions of dollars' worth of cryptocurrencies. The fundamental issue is that blockchains were designed to be transparent. Keeping data associated with smart contracts, private, is therefore a challenge. "We need to build privacy-preserving technologies into smart contract platforms," says Dawn Song, a professor at the University of California, Berkeley, and the CEO of Oasis Labs, a startup that's working on ways to do this using special hardware (Giles, 2019).

The emergence of quantum computers poses a huge threat and could become a tool for breaking encryption. Security experts predict that quantum computers could crack encryption that currently helps protect everything from e-commerce transactions to health records. Quantum

machines are still in their early stages, and it could be some years before they pose a serious threat. However, products like cars whose software can be updated remotely will still be in use a decade or more from now, and the encryption baked into them today could ultimately become vulnerable to quantum attack. The same holds true for code used to protect sensitive data, like financial records, that need to be stored for many years. A recent report from a group of U.S. quantum experts urges organizations to start adopting new and forthcoming kinds of encryption algorithms that can withstand a quantum attack. Furthermore, governmental organizations like the U.S. National Institute of Standards and Technology are working on standards for post-quantum cryptography to make this process easier (Giles, 2019).

### **Blockchain**

Given the rapid growth of data and the emergence of new regulations, it is evident data storage becomes a concern. For a company to succeed in a world fueled by consumer data, they will need to guarantee the protection and safety of consumer's personal information. Blockchain could be the answer to society's growing concern of data protection and security. It democratizes power and control, to make information available across an entire network instead of one individual source. We believe Blockchain promises a future of transparency that will lead to an increase of trust, in a society that has become extra alert and hesitant to trust organizations.

A Blockchain is a growing list of records or data, called blocks, which are linked using cryptography. Each block contains a cryptographic hash of the previous block a timestamp, and transaction data, generally represented as a Merkle tree. Blockchain technology allows for the protection of the data in its original form without tampering. Blockchain can document anything of value and maintain integrity in these blocks of data, that is chained together. As the data is not stored in one central source, not one individual or organization holds the data, preventing anyone from having sole access and power to manipulate. (Blockgeeks, 2016). We believe that Blockchain has the enormous amount of power that can affect society on many levels. During our research we uncovered that Blockchain technology has the potential to play an integral part of GDP. A World Economic Forum survey recently forecast that 10 percent of global GDP could be on Blockchain-based applications by 2025. The technology is also being tipped to revolutionize a wide range of industries and processes from banking and finance, intellectual property, medical records, and supply chain management, to name a few. Blockchain can

connect the “buyer” to the “seller” without a middleman, therefore creating a greater efficiency. By increasing efficiency and cutting out unnecessary costs, Blockchain is an example of a technological advancement and innovation that improves the user experience, while protecting data from improper use and manipulation.

A revolutionary aspect of Blockchain is the ability to digitally track, record, and verify the legitimacy of all transactions. According to our survey, 70 percent of people would prefer to purchase products that they know exactly where and how they are made, including the source of all materials that are used to make the product. Blockchain will be extremely beneficial to retail, especially the luxury sector, as the IoT rolls out to material products. In May 2019, luxury retail giant, LVMH announced they are launching the first global Blockchain designed to help consumers trace the origin and authenticity of luxury goods. This will allow LVMH to have complete control over their products and ensure they are authentic as well as ethically compliant with sourcing and selling regulations, while also decreasing counterfeit activity (WWD, 2019). Blockchain is also being utilized within the high-end jewelry industry. Last Fall, Debeers unveiled that they are leveraging a Blockchain-based platform that tracks the lifecycle of diamonds from the mining stage to retail, to ensure transparency in that their diamonds are being sourced ethically (Wood, 2018). In the future, Blockchain will become critical for the retail industry due to its provenance and transparency offerings. However, the protection and validation that Blockchain provides is threatened by quantum computing. Recently, a paper by computer scientists published in Nature magazine predicts quantum computers will be so powerful they will have the ability to break public key cryptography and codes that hold the Blockchain network together. Blockchain technology is dependent on its unique creation of hard-to-forge digital signatures. Blockchain networks are unfortunately solely reliant on these signatures as there are no human checks to strengthen the defenses. Quantum computers are predicted to evolve to be 100 million times faster than our current systems, and if this is true, it will become very easy to work out mathematical equations and decode encryptions, thus making Blockchain exploitable. If left in the wrong hands, someone with access to a quantum computer can forge a digital signature, impersonate the user, and use their digital assets while taking complete control of Blockchain (Roe, 2018).

IBM has already created a 50-qubit quantum computer, and more powerful machines are in the pipeline. It's only a matter of time before they become capable of undermining trust

Blockchains. But a key part of the infrastructure necessary to make this kind of quantum Blockchain work is not yet available: a quantum web. This is a network that can transmit quantum information via quantum routers without destroying its quantum properties. This kind of system is currently being designed and expected to be rolled out in Europe, the U.S., and China in the near future. A quantum web would allow for secure data transfer. Investments need to be made in this space to uphold the benefits and security of Blockchain technology. Indeed, the job of building such a system is essentially an engineering task rather than one of fundamental physics. So it's just a matter of time before a quantum Blockchain becomes possible (Emerging Technology from AirXiv, 2018).

### **Quantum Computing**

Quantum computers have the potential to become one of the great scientific breakthroughs of the 21st Century. As the amount of readily-available data drastically increases, the need for the data to be processed by computers will grow exponentially. We currently use classic computers to aggregate data and provide insights for potential opportunities. Classic computers are a large scale integrated multi-purpose computer. They use binary codes i.e. bits 0 or 1 to represent information. Classic computers can perform two functions: they can store numbers in memory and they can process stored numbers with simple mathematical operations, like add and subtract (Giles, 2019). They can do more complex tasks by stringing together the simple operations into a series called an algorithm. For example, multiplying can be done as a series of additions. For simple calculations the classic computer easily completes the task. However, the classical computer can only be in one basic state at a time, which would take thousands of steps to complete a complex computation (Rouse, 2010).

The idea of a quantum computer was proposed by Nobel Prize-winning physicist Richard Feynman in 1982. Experts envision these computers to perform tasks that the most powerful supercomputers can't handle. A quantum computer is a high speed parallel computer based on quantum mechanics. It uses Qubits i.e. 0, 1 and both of them simultaneously to run machines faster, minimizing the steps to find the state (Rouse, 2010). While it is not commercialized or made accessible to the public, nor a concept understood by the general population, this invention will have great applications in the future for more efficiencies and power in computing. Operating with nanoscale components at temperatures colder than intergalactic space, quantum computing has the



potential to solve some of the world's toughest challenges. It can take only days or hours to solve problems that would take billions of years using today's classical computers. Microsoft predicts quantum computers will enable new discoveries in the areas of healthcare, energy, environmental systems, smart materials, and beyond (Microsoft, 2019).

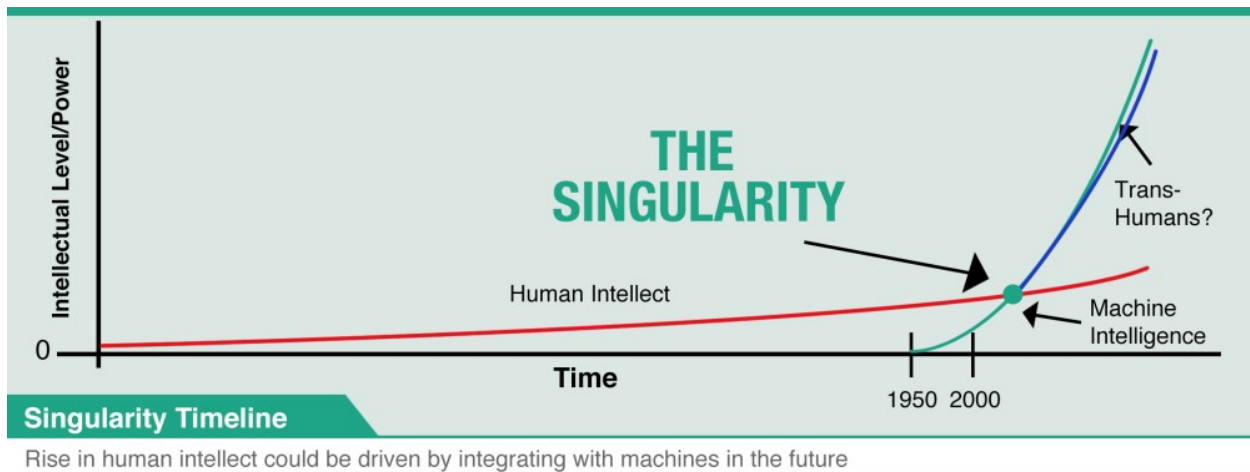
One of the most promising applications of quantum computers is for simulating the behavior of matter down to the molecular level. Auto manufacturers like Volkswagen and Daimler are using quantum computers to simulate the chemical composition of electrical-vehicle batteries to help find new ways to improve their performance. Pharmaceutical companies are leveraging them to analyze and compare compounds that could lead to the creation of new drugs. The machines are also great for optimization problems as they can crunch through vast numbers of potential solutions extremely fast. Airbus, for instance, is using them to help calculate the most fuel-efficient ascent and descent paths for aircraft. And Volkswagen has unveiled a service that calculates the optimal routes for buses and taxis in cities in order to minimize congestion. Some researchers also think the machines could be used to accelerate AI (Giles, 2019).

Quantum computers are in their early stages but are progressing fast. Businesses, governments, institutions and universities have made it a high priority, with billions of dollars invested. D-Wave Systems Inc, a quantum computing company based in Canada, has received more than \$220 million in funding. Investors include Goldman Sachs and Bezos Expeditions, who manage the investments of Amazon.com Chief Executive, Jeff Bezos and venture capital firm DFJ. D-Wave's customers comprise of Lockheed Martin, Google, and NASA. D-Wave technology has been used for selecting investments in financial portfolios, finding promising candidates for new drug development, and studying genomics and particle physics (Deagon, 2019). The quantum computing market is projected to reach \$5-10 billion between 2020-2025 (Market Research Media, 2019). The enormous growth of the global enterprise quantum computing market is expected to be driven by the growing demand for high performance computing in various industries, the rising investments by large market players, and the useful application by medical research and financial markets. Bob Sutor, Vice President of IBM's Quantum Computing Program declared, "Quantum computers are a completely different way of computing, a different beast entirely, and the most significant improvement in computation in the last century" (Deagon, 2019). At the 2019 Consumer Electronics Show, IBM announced its first commercial quantum computer for use outside the lab, The IBM Q System One. The 20-qubit system combines quantum and classical computing parts necessary to

design a machine for scientific and commercial use (Lardinois, 2019). With the power of this computing machine, humans will transition into another chapter in technology that will surpass present day computing, opening up vast opportunities and efficiencies to improve multiple industries.

### **The Next Evolution of AI**

The advancements of data, Blockchain, and quantum computing will lead to a new realm of AI. AI has immensely impacted the daily lives of the global population, however most people do not realize its true impact. The momentum behind AI is building fast due to the massive amounts of data that computers can gather about our likes, our purchases, and our movements every day; and then use to predict what we want and detest (Heath, 2018). The next generation of AI will be the engine that drives huge change. Ben Ross, Mind Your Own Business' User Experience and Product Management leader, predicts we will reach human-level AI by 2040. The term for this evolution of AI is Artificial General Intelligence (AGI) and it will be revolutionary. AGI would be able to combine human-like, flexible thinking and reasoning with computational advantages, such as near-instant recall and split-second number crunching. AGI will be fueled by mass data we don't even realize we are sharing. It will have the ability to advance by itself by accessing and analyzing all data that is transmitted via Google searches, voice search, voice calls, messages, videos, and etc. AI will match human intelligence and allow us to ask questions and find answers more easily by simply asking natural questions to computers. This intersection of intelligence between human and AI is coined "technological singularity." Once this point breaks, AI can surpass human intelligence, and this trajectory will be uncontrollable. Two thirds of AI experts predict AGI will be here within the next 20 years, with more than half predicting it will be available in the next 5-10 years. With this in the near future, integrating human intelligence and intervention in the speedy development of robots, it is imperative to retain control of technology (Robitzski, 2018).



*The Technological Singularity (innovationtorevolution, 2014).*

However, during our research we found Japanese scientists have already built a super-computer that mimics the brain cell network and reached one percent of brain capacity. The process took 40 minutes, to complete the simulation of one second of neuronal network activity in real, biological, time. In the coming years, these super-computers will become the standard. At the moment, users still need to know what you want to know, but in the future, with such supercomputers, it is all about the things that you don't know. The real benefits will be when organizations do not have to ask questions anymore to obtain answers, but simply find the answer to a question they could never have thought of. Advanced pattern discovery and categorization of patterns will enable algorithms to perform the decision making for organizations (Rijmenam, 2018).

From our research we strongly believe, AGI will increase the speed and efficiency for obtaining precise data and create a new layer of visibility around how different countries, cities and people operate. This will influence better societal decisions to satisfy the needs and wants of the people, helping to find opportunities for new services and industries while catering to people's desire for personalized and customized products and services. In a Futurism article, author Dan Robitzski expresses that in this new environment of competitive economy, the success of an organization will depend on its ability to leverage new technologies or their existence will be threatened. Instead of competition, unity will be the driving force of society and enable new approaches in education, labor, welfare and commerce (Robitzick, 2018).

By 2040, everything will be connected and AGI will play an integral part in the retail experience. Since all material objects will have some sort of internet connectivity, retailers will be able to track in-store browsing behavior like never before - taking things like cart size, cart

abandonment, and even ""wish list"" into the physical shopping ecosystem. AI is already on track to save retail an estimated \$340 billion by 2022 by providing the tools for retailers to make smarter recommendations and optimized inventory forecasting (Matthews, 2019). SATO Worldwide, a global pioneer in the development of auto-ID and labeling solutions presented an in-store data capture system for retailers to track individual products, consumers, and associates to deliver efficiencies for retail operators and enhance the customer experience. As retailers in Japan deal with chronic worker shortages, store managers are increasingly seeking ways to maximize store efficiencies. Meanwhile, shopping continues to shift from physical stores to e-commerce, turning the physical store into a venue to learn about products hands-on before purchase. More and more, customers expect the digital experience at brick-and-mortar stores. SATO aims to enable this through the tagging of items with identifiers using cutting-edge radio wave technologies. This next-generation radio-frequency identification (RFID) system is predicted to be powered by paper-thin battery-free Bluetooth Low Energy sensor tags. The sensor technology, which minimizes costs for system implementation and data processing, tracks and transmits a wide range of data on movement and status of items and people within the store (associates and customers). It provides insight into purchasing behavior and enables labor savings for product management while also providing appealing in-store services. The system aims to greatly streamline processes to cut costs and enhance the customer experience (SATO Worldwide, 2019). Leveraging AI in retail can improve customer experience and retailer efficiencies. This was observed in San Francisco, where customers can try on clothing through virtual interactive mirrors at Reformation. In Hong Kong, we interacted with touch-screen beauty assistants at various shopping malls and beauty counters. In South Korea, advanced automation at General Motors was incorporated into their production line to reduce human error. As AI evolves to AGI, AGI can fuel retail experiences far beyond operational efficiencies and connections with consumers.

### **Machine Learning and Bias**

Data and AI evolution will provide the tools to satisfy the needs and wants of society. Before going any further, we need to understand how AGI will form. AI is fueled by machine learning. Machine learning is where machines are continuously learning and improving, all by themselves. Imagine AGI learning similar to that of how mammals learn, by mimicking mirror neurons. Mirror neurons are the scientific component of the saying, “monkey see, monkey do.” Mirror neurons are

cells in the brain that respond and understand when an action is performed, therefore allowing that individual to attempt to replicate (Del Giudice, 2009). Machine learning will power AI into such an advanced forward state of computing, that we will no longer be able to tell the difference between AI and humans.

This form of learning bypasses language, which AGI will have the tools to do. AGI will have access to the ever-growing magnitude of data and observe, learn, and imitate at a quantum computing speed. The problem is, this technology lacks the human element. It will lack empathy. It will lack understanding. These new forms of AI will portray the ability to understand feelings, but won't actually feel them. And what if the information the machine is learning from isn't completely accurate? AI bias and discrimination is a reality and we are already seeing this happen today. Joy Buolamwini, a computer scientist at the MIT Media Lab, researched facial recognition technology that was created by Amazon, Microsoft, and Google and found astounding results. The AI misidentified Michelle Obama, Oprah Winfrey, and Serena Williams as male, and was extremely confident in the accuracy of its analysis. For black women, AI can be wrong up to 35 percent of the time (Buolamwini, 2019). These companies are selling their AI algorithms that include facial recognition software to large entities that can significantly impact society such as the FBI. It is critical to ensure that machine learning is done ethically and accurately or else we will start to see significant disparities within society. With great advancement in data in the future, a world of infinite information will be a reality. If society does not take the proper precautions now, the welfare of society could be at risk.

### **TECH & WELFARE**

Society norms will be completely redefined and the interest of civilians and the environment will need to be carefully considered as technology advancements shift at an unprecedented higher rate. While advancements in technology are moving society towards the Fifth Industrial Revolution, the welfare of society will be significantly affected. Precautions must be taken and the people of society must be equipped with the necessary tools to prosper. Imbalances of wealth and level of technological developments will persist, however, the consciousness and effort to minimize the divide will be the key to unlocking the Fifth Industrial Revolution that is beneficial to all. According to Dr. Madsen Pirie, president of the Adam Smith Institute, "It was the [Third] Industrial Revolution

that generated the wealth that paid for advances in public health and sanitation. It led to the conquest not only of extreme poverty, but of curable and preventable diseases. Far from bringing poverty and misery to the masses, it did the opposite, lifting their material conditions at a rate and to a level never before witnessed in human history. It was one of the most benign events that people have brought about, and it set the world on an upward course which still benefits millions of people today.”

### **Regulation for Welfare**

The shifts into greater technological advancements means new ways of operating in our society. With any introduction, adjustments are necessary to adapt with unknowns and unexpected features of the technology. A historical example of a new technology development led to a devastating event due to an ignorance to the risk of the technology. March 25, 1911 marks the deadliest industrial disaster in the history of the New York City, and one of the deadliest in the U.S: the Triangle Shirtwaist Factory fire. The fire caused the deaths of 146 garment workers – 123 women and 23 men – who died from the fire, smoke inhalation, or falling or jumping to their deaths. The factory was located on the three floors of the Asch Building, at 23–29 Washington Place in the Greenwich Village neighborhood of Manhattan. The 1901 building still stands today and is known as the Brown Building. While the factories had new machinery and tools to increase production, there was not proper protocols or precautions to how the workers were treated. During the early 1900s, it was common practice to lock the doors to stairways and exits to prevent workers from taking unauthorized breaks and to reduce theft. During an accidental fire from the machinery, many of the workers could not escape from the burning building, and therefore their lives were sacrificed from the fire or jumping from the high windows. The fire led to legislation requiring improved factory safety standards and helped spur the growth of the International Ladies' Garment Workers' Union (ILGWU), which fought for better working conditions for sweatshop workers. Without this event, people would not be aware of the devastating threat to their livelihood.

We have identified that it is imperative that as technology grows, there is a need for regulation and active education to better understand and avoid possible pitfalls that would lead to the modern-day equivalent of the Triangle Shirtwaist disaster. It is important to recognize the benefits and drawbacks and society cannot be blinded by the efficiencies and conveniences from technology.

When managed with the proper regulation and understanding of technology, society can then reap the highest potential that new technology offers.

### **Advancing Societies with Technology**

Technology has given underdeveloped countries the power to grow more rapidly than their developed counterparts. Specifically in the last decade, India, the second largest online market after China, has over 460 million internet users. In 2015, only 26 percent of these internet users had access to the internet. It is predicted that by 2021, there will be over 635 million internet users in India (Statista, 2019). In India, WhatsApp, owned by Facebook Inc., has over 200 million users. This is the most WhatsApp users in any single country. The platform is said to be the most popular messaging service because of easy registration. Due to such high penetration in the market, telecommunications regulators are looking into new regulations for WhatsApp and other services that use mobile operators' infrastructure to allow the government access to users' messages to prevent high rates of national violence, as officials can track rumors of negative activity through chat.

India is also utilizing technology to help them improve the organization of their country. India is a country that operates on traditional ways of documentation and data collection. As a country that has been deeply rooted in traditional methods of in-person communication, local relationships and paper records, there is a lack of unification and centralization of data, creating inefficiencies and prohibiting the ability to scale for efficiencies. IndiaStack was launched, creating a set of application programming interfaces (APIs) that communicates and allows governments, businesses, startups, and developers to utilize a unique digital database to develop an infrastructure to solve India's problem of disorganization and lack of centrality. Aadhaar is a 12-digit unique code given to residents which is under the jurisdiction of the Unique Identification Authority of India (UIDAI). In January 2018, 20 countries expressed interested in adopting Aadhaar technology. The ability to have an easy storage and retrieval of information and documentation digitally reduces the reliance of old and slower paper systems. Additionally, there is a cashless layer to IndiaStack which allows for traceable transactions and the ease of transfers between bank accounts. Both individuals and merchants can digitally, securely and instantly transfer money by simply creating a virtual

payment address without the need to rely on offline systems, or going in between online and offline systems. While there is a lot of information stored on the platform, the inclusion of a consent feature allows the user to securely benefit from the use of the technology and its convenience, while giving them the ability to authorize data flow between data providers like banks, hospitals and telecommunications companies to data requestors like banks and credit card providers. This allows for seamless communication between merchants, providers, and services to the user's existing information and provide documentation of identity and other necessary data for quicker approval of services. The benefits of systems and technologies like the one provided by IndiaStack improves the flow of information and efficiencies in developing countries like India. We have recognized that, by leveraging technology, nations can increase their potential of greater welfare of the people.

Another example of technology's positive impact in India, is the Self-Employed Women's Association use of technology to communicate with short messaging service (SMS) to send agricultural workers messages about commodity prices. This information helps farmers determine best places to sell their produce in order to optimize their profits. Farmers who participated in this program have said that they have been able to sell their products over wider areas, which have increased their income. Another example, also in India, is the Hand in Hand Partnership (HIHP). The HIHP is an organization that provides women with mobile devices so that they can launch their own tech-driven businesses. The HIHP helps train and provide technical support for these women. Women are encouraged to innovate with new ideas and learn application to maximize the technology they have, therefore creating a more sustainable, long-term path to self-sufficiency. While there have been advancements globally, we see segregation and barriers within local communities, legislation, and regulation that cause economic limitations and nuances within regions. These factors impact the way regional societies evolve within the growing technological landscape. Developing countries, such as India, that have once opted out from global trade, advanced technology, and international relations, are now accelerating due to the adoption of technology. These nations, while at the cutting edge of progress, may be priming themselves for global dominance.

### **Technology and Rejection**

In contrast to the heavy reliance on technology, there are growing counter-culture



movements to disengage from technology. According to an app called Freedom, over 750,000 people have used their app to block websites, apps, and the internet to help them disconnect from distractions. This disengagement is sometimes related to mindfulness (mindful disengagement) and results in controlling the amount of time spent on activities that are powered by advanced technology such as time spent on smart devices. As time is the new form of luxury, it is increasingly important to protect the time to be “unplugged”. On the extreme end, there are people who refuse to engage with technology entirely and live life without TVs, computers, cell phones, and even household appliances, which they consider to be too controlling in their lives. As the negative impacts of technology have become more apparent, there are more people moving away from technology.

Neo-Luddism or new Luddism is a philosophy that opposes modern technology, and is based on the concern that technology will have on individuals, their communities, and the environment. This philosophy stems from the historical legacy of the English Luddites, an organization of textile workers that protested the use of machinery to remove standard labor practices, which diminished the skills of their crafts, and ultimately replace the need for their work. The fear of machinery or “technology” threatening jobs is even more present today, notably in factories where automated machinery is replacing line workers. While the average person who rebels against technology doesn’t not often refer to themselves as a Neo-Luddite, the Neo-Luddites of today consists of those who resist modern technology in different forms. These forms include passive abandonment, advocating simple living, harming those who produce technology, or sabotaging technological devices.

In 2001, Francis Collins, then head of the Human Genome Project, claimed, "major anti-technology movements will be active in the U.S. and elsewhere by 2030" (Bailey, 2001). Examples of recent anti-technology activities include NYC taxi drivers protesting the impacts of Uber, local residents in San Francisco protesting Google, and the negative impact it has had on its housing prices (Guyenn, 2018), and the protests against Amazon opening an office in Long Island City, New York. While these have been newsworthy acts of protest against technology and those who produce it, technology rebellion is happening around us. The direction in which we move as a society with technology is not to choose either the mindless infiltration of technology or the denial of its power, but an integration of the two. It is undeniable that technology has the power to better societies.

However, for those without adequate knowledge, their ignorance causes fear and feelings of a loss of control. We believe that it is imperative to equip society with the necessary tools to become more informed, educated, and conscious about technology's existence. Technology must work in conjunction with humans to improve our standard of living. It is important to invest in human development in parallel with technological advancement to ensure our society flourishes for future generations to come.

### **Access and Disparities**

With greater opportunities for technology to improve various aspects of welfare - health, access, labor and education - we must acknowledge the implications of inequality across the globe. From the most developed nations to the top 2 percent of individuals in society, only a select few who are endowed with resources and the financial means will be able to access the gains from technological advancements, allowing them to prosper and grow alongside technology. However, only 56 percent of the global population has access to the internet (Internetworldstats) and its basic features. Our Technology and Society Survey of over 300 individuals living in the U.S., identifies that 53 percent of people feel that they have access to the most current technology and utilize it. Conversely, almost a quarter of people in the same survey feel that that they do not have access to the most current technology. This conflicting sentiment does not vary significantly by age. The inequality will create a significant gap in the population that will divide the world further into segments based on levels of access to technology. Some of the greatest examples of this divide is exemplified in the world's most developed economies. Societies with technology advancements that grant them freedoms and greater efficiencies through digitalization have created divides within populations within countries like the U.S. and Sweden.

In April of 2019, the U.S' fast-casual salad chain, Sweetgreen was forced into reversing its decision to stop accepting cash as a form of payment in its restaurants (Bloomberg). The salad chain's decision to go cashless in December 2016 was an initiative to go digital and reduce paper waste. Unfortunately, this initiative disenfranchised customers who did not have credit cards or a line of credit. In February of 2019, Philadelphia's City Council approved a bill banning stores that don't accept cash as it is a practice that discriminates against customers who might not have access to lines of credit or mobile payment applications. According to the Federal Deposit Insurance Corp, six

percent of Philadelphians lack a bank account. Cities like New York and San Francisco and the state of New Jersey have since mandated businesses to accept cash. Despite estimating that only five percent of Sweetgreen customers will pay in cash, it is the unequal access to financial means that still creates a divide within nations. According to The Guardian, the greater U.S. population relies on cash as a preferred method of payment. A report published in 2017 by the Washington City Paper found that 27 percent of people in the U.S., roughly equating to 60 million Americans, would have trouble using only a credit card to purchase products.

Internationally, Sweden has been one of the first countries in embracing new technologies. And its financial system is not the exception. As mentioned earlier, Sweden is leading the way in becoming the first cashless society and it is estimated that by 2023, cash will not be accepted any longer as a means of payment in Sweden (Fourtane, 2019). Yet, even Sweden has seen an enthusiasm gap emerge, mostly along demographic lines. Older people in the rural north who are the least tech-savvy, resent the economic power of Stockholm and Gothenburg, which have become almost entirely cash-free urban zones. The National Pensioners Organisation is a key player in the “Cash Uprising” coalition now campaigning to make sure older Swedes can still deposit and remove cash from banks (The Guardian, 2018). In addition to the uproar from the older generation, the bank is also forced to adapt with the emergence of electronic forms of payment. The printing of cash, traditional banking and tellers, and management of accounts has been dramatically impacted. In developing nations, we see greater divides in the ability to afford a cashless system. The 2017 World Bank Global Findex database, which measures financial inclusion, estimated that some 200 million Chinese rural citizens remain unbanked, or outside of the formal financial system. Cashless payment systems by design require formal enrollment in banks, which are then tied to the mobile payment platforms that WeChat and Alibaba host. Without access to technology, an individual in one of these developing nations remain excluded from intended conveniences that are offered by the technological advancements.

Another example of how a divide in society is evident from the difference in access to technology and financial means is one that is visible, superficially. In January 2019, journalist Jaya Saxena researched the connection between the state of skin and poverty. This is particularly interesting as skin is the most visible testament to one’s lifestyle. “We assume those at the top are

there because they have done something right. And if they have straight teeth, toned bodies, and smooth skin, that must be ‘right’ too,” she wrote. “It’s not that we think having bad skin is a moral failing. It’s that we think poverty is” (Mull, 2019). She concludes that healthy skin, is therefore not achieved through routine, rather through financial means. Skin-related issues such as cystic acne or dermatitis, require a dermatologist in addition to maintenance. Technologies and medicine have allowed transformative results in skincare with cosmetic procedures costing upwards of thousands of dollars. This all comes with a high price. Saxena admits that “good” skin comes with a healthy diet and a job that allows for steady sleep patterns, however these are luxuries awarded to those with higher incomes who can afford these high-tech procedures and treatments for quick fixes. Saxena’s research implies that technology can have a negative impact on bringing “classes” together. The improvements of technology will be best utilized and appreciated by those who have capital that can afford a lifestyle that allows for a physical transformation, showing visible differences in levels of wealth. With the high cost of technological-related treatments, the disparity and divide will continue to grow.

Access to technology has created divides in populations within a country and across the world. As visible in variations to digital forms of payment and convenience; and differences in superficial appearances, there are far greater implications to society. The differences in access and the progression of technological advancements lead to divides across populations based on wealth and accessibility to technology.

### **The Future of Labor and Education**

The access to technology will also create a divide in the future of labor. It is estimated that in the next 15-20 years, 14 percent of existing jobs could disappear as a result of automation. While there has been an increase in financial technology and digital platforms, traditional labor skills have continued to be less relevant in the midst of technological advancement throughout the world. According to the Organisation for Economic Co-operation and Development (OECD), the digital transformation, globalization, and demographic changes have resulted in the change of labor and work. The labor that has relied on unions to protect labor rights have also experienced a negative impact. Union membership has steadily declined over the last three decades in OECD countries,

falling from 30 percent in 1985, to 16 percent in 2016. The trends have shown the weakening of workers' bargaining power and led to the decline in the share of income of workers, nationally. Non-standard workers are 50 percent less likely than standard workers to be unionized, and therefore, less protected from the volatility of the changing labor market.

As employment and desired skill sets continue to change to adapt to technology, the divide will become more apparent without the proper education and training. Those who have access to education in research universities and on-the-job training in technology-driven roles will be first served with the necessary training to evolve, but the working class will have a lot of catch up to do. As it relates to on-the-job training, this new emergence of a gig-economy, first introduced during the financial crisis of 2008, will allow workers to be less at the mercy of automation with technology. A gig economy is premised around a short term assignment or temporary work where a person is employed for a specific project or task, with a definite end period. Applied in a corporation, this would be analogous to a task-force, or the shadowing and rotation across different functions, allowing each employee to be more knowledgeable about the cross-functional operations of the company. The idea is that these small teams and economies will generate income in the organization (Frazer, 2019). The analytical and soft skills acquired from a gig-economy will be invaluable skills that cannot be learned by AI, which is designed to specialize in automation of one specific task.

Without adequate resources to obtain education, the disadvantaged layer of society with fewer technological resources will continue to fall far from those who continue to have access to education and growth. To prepare the youth of society for the future of labor, we need to ensure that the young generation of today is properly educated for the jobs of tomorrow. A 2015 study found that the typical American student is required to take 112 standardized tests between pre-kindergarten and 12<sup>th</sup> grade. Meanwhile, students in most countries that outperform the U.S. on international exams are tested just three times during their school careers (Lynch, 2019). High standards and the need to achieve strong performance-based outcomes in reading, writing and math have been the main focus in the past but today, many are questioning if it is time for change. Leaders in the educational industry believe it is important to acknowledge there are other leading indicators of success for all students, starting in kindergarten or earlier, that are important factors in strong life outcomes for students, schools, and communities once students leave school and go on to college or

careers. These indicators include encouraging and monitoring growth in important career and citizenship skills such as social-emotional learning and critical thinking (Ark, 2019).

Many believe “one size does not fit all”, and that personalized learning should replace standardized testing altogether. Personalized learning models would allow students to move at their own pace and pursue their own interests, taking into account individual strengths and weaknesses. In the digital age, these models are highly dependent on technology. Software and online programs could be used to provide targeted instruction based on individual student performance data. The ultimate goal is to design adaptive tests that are more interactive and responsive to students. Personalized learning is by definition is unstandardized, which raises questions of equity and fairness when it comes to testing. Others argue that non standardized testing is fair: intelligence and learning themselves are not standardized, so assessment shouldn't be either (Lynch, 2019). As humans evolve into becoming more “human” and differentiated from AI and programmable standards, unique personalized learning models will become more sought after. It is the need to utilize technology to help us gain knowledge, rather than to continue to go with old forms of education that will make human skills obsolete in the world of technology.

The gradual shift away from standardized testing towards the performance snapshot model will change the conversation from “what was my grade” to “how can I better understand?” Learning to fulfill the needs of a standardized exam or reading from textbooks has become a limited way to learn a subject and is becoming a thing of the past. Instead of just reading a chapter on solving equations, look at the text online, watch a super-engaging video that shows you how to do something, and play a game that reinforces the concepts. The growing sources of education from technology has expanded online and through software that creates new quizzes to focus on the ideas that requires more understanding and mastery (Gates, 2019). Students learn best when they are immersed in study through interaction and application, and not from reading a book or listening to a lecture. So it's no surprise that we are entering a new era of educational resources. One in which, due to advances in technology in the classroom, the textbook, is becoming obsolete. Nearly seven out of ten teachers claim that having state-of-the-art IT equipment, such as interactive whiteboards, is more important than investing in traditional textbooks. And 30 percent of those polled predicted that textbooks will become obsolete in the future due to the rising use of gadgets in classrooms

(Wardrop, 2010).

According to the 2016 State of Technology in Education, published by Promethean, 32 percent of educators were using technology to bring experts or experiences into the classroom, virtually. The use of technology in education is rising rapidly, with expenditures in education technology predicted to grow at 17 percent per year, to reach \$252 billion globally by 2020. It makes sense that the tools being utilized in the classroom to learn, should reflect what will be most helpful for what's to be applied in the workplace; an environment where paper-based media has already been replaced by online content, applications, and tools (Resource Ed, 2017).

### **Technology Extends Life Expectancy**

Technology has the power to dramatically extend human life expectancy. According to CNBC, innovation in genome science and big data coming from the latest in wearable technology and products in the wellness space is predicted to prolong healthy human life beyond 100 years (Franck). Today, modern medicine has effectively doubled the average lifespan in a little over a century (Marr, 2017). Antibiotics, sterilization, and vaccines ushered in a new age of health and longevity that expanded our life spans, while new technologies, including robotics, AI, and data will further extend our lifespans. Bank of America believes that one of the biggest investment opportunities in the next decade will be in companies that delay human death, a market that is forecasted to be at least \$600 billion by 2025. Genomics is expected to be a \$41 billion industry by 2025, and will provide the next level of gene editing, creating evolutionary advances in medical treatments. Areas such as AI health and future food will be growing along with companies in these areas like genome sequencer Illumina, high-tech players like Google's Alphabet, and biotech companies like Novartis.

In addition to companies investing more into these areas of health, medical technology, and wellness, influential individuals in technology have also invested and donated in these areas. According to Forbes, Larry Ellison, the founding chief executive of Oracle, has given an estimated \$45 million, annually, for over a decade to fight aging. Paypal's co-founder, Peter Thiel, has donated \$6 million to the Sens Foundation that researches aging and longevity. Google's co-founder Sergey Brin personally donated \$50 million to research diseases related to aging that includes Parkinson's,

after he learned of his personal risk of developing the illness. Google's Alphabet has invested more than \$730 million into a company called Calico, with a mission to extend human lifespans. The latest innovations in health and wellness include gene therapies that have doubled life expectancy in mice by editing genes related to aging. Other scientists are researching technologies that allow people to act and feel younger. Some scientists believe that the removal of toxins will also help with healthier aging. Additionally, scientists are learning to create replaceable body parts such as robotic limbs, 3D printed organs and tissues. Improvements in diagnosis and treatments can also increase life spans by preventing diseases, providing better treatment plans, and custom treatments.

With longer life span, comes shifts in work and retirement. The US News and World Report published a report on how living longer will impact retirement. In 1960, a 65 year old retiree had an expected 13-17 years more to live, however, in 2018, the average number of years post retirement at 65 increased to 19-21 years. The Social Security Administration also records that a quarter of those retirees today will live up to 90; and one-tenth of them will live beyond 95 years of age. Many Americans have continued to work for the additional income to support a longer life. Laura Carstensen, founding director of the Stanford Center on Longevity, says with longer lives we have to reshape our visions of retirement. "Most people can't save enough in 40 years of working to support themselves for 30 or more years of not working," Carstensen said. "Nor can society provide enough in terms of pensions to support non-working people that long. I'd like to see us move in a different direction: toward a longer, much more flexible working life, with more part-time work, in which people could come in and out of the workforce and have greater opportunities for education throughout their lives." By changing the way work is today, the standard and quality of living will be much improved for many to do what they enjoy, rather than spend additional years working. The aging population will cause a political shift towards a welfare state with lower cost or free healthcare, forcing society to take greater care of the elderly. As the elderly are going to be a significant proportion of society, they can be a strong voice as advocates for the coming of the Fifth Industrial Revolution.

### **The Great Blend**

As the world of technology evolves, silos must be broken to ensure that both existing and



emerging industries do not go into extinction. Breaking barrier, just as quantum computing has broken the need for binary code, is vital to making a blended world where industry, energy and the greater need for regulation can live in harmony. Similar to the formation of gig-economies to keep humans at a competitive advantage over AI and automation, companies also need to evolve into more flexible operations in order to stay relevant and irreplaceable. Since the late 1800's, companies have undergone mergers and acquisitions (M&A) in order to expand their businesses through building synergies, applying learnings across companies to build competitive advantage. It has become more apparent today. Big companies are taking over the U.S. From telecommunications, retail, banking, and healthcare, larger corporations are capturing market share from smaller players through mergers, acquisitions, and greater capital investments from private equity. While M&As have remained largely within industry types, recent trends show that mergers across industries are becoming increasingly enticing. There is an increasingly holistic perspective of businesses, just as we have seen approaches to education and training in the labor force. More and more corporations are looking to understand differences and similarities between themselves and competition or cross-industry companies to identify suitable partners. As the world is evolving to be more holistic and integrated, the merging of industries creates competitive advantage for companies to have greater success, synergies, adoption of infrastructures, and long-term sustainability, ultimately increasing the bottom line.

In June of 2017, Amazon, the pioneer of online shopping, agreed to buy the upscale grocery chain, Whole Foods for \$13.4 billion, in a deal that instantly transformed online shopping into a merchant with physical outposts in hundreds of neighborhoods across the country. At the time, the magnitude of the grocery business was about \$800 billion in annual spending in the U.S.. This deal would turn Amazon into a more frequent shopping habit by becoming a bigger player in the food and beverage industry. For years, Amazon failed at selling groceries online, as its customers had shown a disinterest buying items like fruits, vegetables and meat online, and preferred purchasing these items in person (Wingfield, 2017). In November 2018, CVS Health and Aetna closed a deal for a \$69 billion merger, creating a new health-care powerhouse. The merger combines CVS' pharmacies with Aetna's insurance business, blurring traditionally distinct lines in hopes of making health care local and accessible, simplifying how consumers access care and lowering costs.

The global wellness market has skyrocketed to a \$4.2 trillion industry and has grown 12.8 percent from 2015 to 2017 (NPD Group, 2018). We are already starting to see a natural progression of technology acceptance within these industries and as they partner and cross-innovate to cater to the changing needs of the consumer. An example of adaptation of technology to improve wellness is the 2018 partnership between La Roche-Posay and Apple, teaming up to launch an innovative wearable UV tracker. The clip-on device, called My Skin Track/UV, tracks environmental stressors that affect the health of your skin, including UV rays, pollution, humidity, and pollen levels, and send all the information to an app on your phone (Dancer, 2018). Guive Balooch, who led the device's research and creation at L'Oréal's Technology Incubator, stated "We believe that the future of beauty is closely tied to health and incorporating technology to give people personalized ways to take better care of their skin." (Dancer, 2018).

## **TECHNOLOGY & ECOSYSTEM**

By 2040, the welfare of planet Earth and the well-being of its inhabitants will be of utmost importance. In 2040, we will be living in a world where global climate change, food shortages, the depletion of natural resources, and air pollution is stabilized. More than half of the population will live in a digitally connected super city, where power is harnessed from bacteria and recycling has been built into the lifecycle of every manufactured product. New smart energy sources will allow for in-home fuel productions, and space exploration offers new frontiers for resource mining. We believe that advancements in technology and quantum computing will have the ability to reverse the current state of our distressed ecosystem, and revive the Earth from an otherwise guaranteed path to extinction.

### **Technology and Natural Resources**

Without the implementation of technology and quantum computing on a global scale, planet Earth will continue to deteriorate until its ultimate destruction. In 2018, the Intergovernmental Panel on Climate Change (IPCC) issued a special report on the devastating impacts of global warming of 1.5°C above pre-industrial levels. The report warns of a future of global food shortages, increased catastrophic natural disasters and the loss of coral reefs as soon as 2020. The IPCC report analyzed more than 6,000 scientific studies concerning the impact of human activities on global warming and

the impending destruction to Earth's ecosystem. The emissions of greenhouse gas (CO<sub>2</sub>) due to human activity has increased by over 400% since 1950. The leading part of this increase is the burning of fossil fuels, including coal, petroleum, and natural gas. Fossil fuels currently supply 85 percent of the global energy source (Metcalf, 2019). The IPCC report heavily urges for a world-wide reduction of greenhouse pollution of 45 percent by 2030, and to increase the use of renewable energy by 67 percent in order to reverse the effects that human activity has had on the planet (Davenport, 2018). The burning of fossil fuels is not only causing alarming amounts of CO<sub>2</sub> emissions, but it is the number one cause of global warming. More so, there are not enough fossil fuels left to support the planet (Arkin, 2017). A recent study published by the The Midcounties Co-operative, the United Kingdom's largest independent co-operative, reported that if the use of fossil fuels is not reduced, global supplies will be depleted by 2060 (Coop Energy, 2016).

The depletion of fossil fuels is not the only consequence of global warming. On May 6th 2019, the United Nations Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) released a 40-page summary of an upcoming 1,500-page report on the state of biodiversity on Earth. The report stated that, "the health of ecosystems on which we and all other species depend is deteriorating more rapidly than ever. We are eroding the very foundations of our economies, livelihoods, food security, health and quality of life worldwide" (United Nations, 2019). The report disclosed that one million animal and plant species are currently threatened with extinction; an extinction that is a direct result of humans and human activity on planet Earth. Human activities have resulted in natural habitat loss, the spreading of invasive species, a drastic increase in pollution and global climate change (AMNH, 2019). The species most threatened includes, "40 percent of all amphibian species, 33 percent of corals, and around 10 percent of insects" (Resnick, 2019). Additional reports from the World Wide Fund for Nature (WWF) has found that since 1970 the average vertebrate animal population, has declined by 60 percent. The WWF urges countries to not only protect, but expand land offerings to animals. "It is going to take policies that more strongly police the import of invasive species. It means protecting indigenous communities, who use their land in a more sustainable way" (Living Planet Report, 2019).

As a result, to these recent studies and alarming statistics on global climate change and the depletion of natural resources and species, we urge the governing bodies to act on utilizing technology to detect the sources of threat, and areas of Earth that have high risk of deterioration. Recently, representative Alexandria Ocasio-Cortez and senator Ed Markey released a fourteen-page

resolution to the Green New Deal, which would put in place a 10-year national mobilization to reduce greenhouse gas emissions through the use of new technologies. The resolution would strive to achieve,

“100 percent of the power demand in the United States through clean, renewable, and zero-emission energy sources...build energy-efficient, distributed, and ‘smart’ power grids...upgrade all existing buildings in the United States and building new buildings to achieve maximal energy efficiency, water efficiency, safety, affordability, comfort, and durability, including through electrification...overhaul transportation systems in the United States to eliminate pollution and greenhouse gas emissions from the transportation sector...work collaboratively with farmers and ranchers in the United States to eliminate pollution and greenhouse gas emissions from the agricultural sector as much as is technologically feasible” (Rizzo, 2019).

Further sanctions include the United Nations *17 Sustainable Development Goals (SDGs) to Transform our World*. Issued in 2015, the 17 Goals, were founded on the principle of leaving no one behind and achieve full inclusivity by 2030. The goals include clean water and sanitation, affordable and clean energy, sustainable cities and communities and zero hunger (United Nations, 2015). One way in which the UN would achieve this is by leveraging global access to clean energy technology and energy infrastructure. “No one can ignore the vital role of science, technology and innovation...we are in the right place at the right time...to magnify benefits and limit negative impacts” (United Nations, 2018).

Large corporations including Exxon Mobil and IBM are pioneering predictive environmental modeling and carbon-capture technology. Per Vijay Swarup, Vice President of Research and Development at Exxon Mobil, “quantum computing can take our understanding of nature and chemistry to a granularity that has never been able to be done before because the computations are just too hard” (Hackett, 2019). Furthermore, Google’s quantum computer D-Wave two, which performs tasks 3,600 times faster than current computers, will be able to solve the effects of human action on the environment using real-time data. “We can also gain more insight into how we are influencing our climate because quantum computers will help us build better climate models. The sooner we know how things are expected to shift, the better we will be able to prepare and respond to climate change and its impact” (Marr, 2017). Climeworks and Global Thermostat are focusing on expanding carbon (emission) capture technology. Carbon capture technology can capture, use and store more than 90 percent of CO<sub>2</sub> emissions from industrial and power plant emissions (C2ES, 2019). The carbon captures can then be manufactured into fuel, fertilizers, and

building materials. According to Center for Climate and Energy Solutions, “carbon capture can achieve 14 percent of the global greenhouse gas emissions reductions needed by 2050, and is viewed as the only practical way to achieve deep decarbonization in the industrial sector” (C2ES, 2019). From the implementation of global regulations and the use of quantum computing and carbon-capture technology, our research shows a future without the catastrophic effects of global warming and the depletion of natural resources.

### **The Future of Renewable Energy**

Our research shows that by 2040, the cost of renewable energy will be cheaper, more powerful, and replace the need for fossil fuels. Including solar, wind and geothermal energy, 2015 marked the first year that as the global economy grew, carbon emissions did not, as renewable energy sources were used more than fossil fuel (Tal, 2018). Solar energy produced from the sunlight, is one of the most promising forms of renewable energy. Recent solar technologies advancements include photovoltaics (PV) solar powered roads and sidewalks, fabric solar panels and solar thermal fuels (STFs). In 2018, the sidewalks along America’s historic Route 66 were paved using solar-powered panels. The panels were able to power local light-emitting diode (LED) bulbs and produced thermal heating to melt snow. Wearable fabric solar technology expanded to include softer, non-plastic materials including window curtains and car seats, bringing solar heat to both the home and car. STFs, a solar powered battery, has resulted in on-demand solar use. Recent prototypes from MIT, “saw the invention of a solid state STF application that could be implemented in windows, windshields, car tops, and other surfaces exposed to sunlight” (Richardson, 2019). According to Quantumrun Future Forecasting, by 2030 solar energy will cost only a fraction of traditional fossil fuels. Furthermore, by 2040, super batteries will go mainstream, and power households, businesses and cities. From electric cars to Tesla’s Powerwall battery, the race to build a better battery has begun. According to futurist David Tal, “batteries like these allow households the option of going entirely off the grid...you can adjust your energy usage to collect and store energy during the day when electricity prices are low, then go off the grid by drawing household power from your battery at night when electricity prices go up” (Tal, 2018). Other forms of technologically advanced renewable energy include Cyanobacteria, which can produce energy from the sun (photosynthesis) in combination with carbon dioxide. “Cyanobacteria is a win-win, as it doubles as biofuel, but also rids carbon dioxide from the earth’s atmosphere” (Lutz, 2019).

However, the commercialization of Nuclear Fusion will be the biggest technological advancement in energy production. According to the World Nuclear Association, “fusion power offers the prospect of an almost inexhaustible source of energy for future generations” (World Nuclear Association, 2019). Nuclear Fusion is a clean and “an almost infinite, cheap energy source...that will make the cost of energy negligible” (Daniel, 2018). Companies such as TAE Technologies and General Fusion are leading the race to perfect fusion energy. The CEO of TAE Technologies, Dr. Michl Binderbauer confirmed that TAE will begin Nuclear Fusion energy commercialization efforts by 2023. General Fusions agrees, saying “we can't get fusion plants up fast enough to phase out greenhouse gases overnight...we've got to go through that phase-in to where fusion will become the main energy source, and it will in the long run, in this century” (Pittis, 2019). The benefits of using renewable, nuclear energy is that they are all clean, smart, and will power our planet for infinite years to come, therefore removing the need to use coal or oil.

The promising future of space exploration offers an additional solution to the global energy crisis. Samsung projects that colonies will soon appear on the Moon and Mars, and that Mars will be used to mine clean water. Additional resources include lunar water and titanium rich soil on the moon. Within the next twenty years, technological advancements will allow for water to be mined in space. Furthermore, space offers the possibility of capturing solar energy via solar panels that orbit the earth. Dr. Massimiliano Vasile, University of Strathclyde's Department of Mechanical and Aerospace Engineering, who is leading the space based solar power research, states that, “space provides a fantastic source for collecting solar power and we have the advantage of being able to gather it regardless of the time of the day or... weather conditions.” Dr. Vasile explains that solar power from space can be directed to specific areas on the globe that lack constant access to sunlight and solar energy. Referred to as solar farms, China announced plans to place a solar farm in space by 2050, “a feat that would make it the first nation to harness the sun's energy in space and beam it to Earth” (Chow, 2019). China is currently building a test facility in Chongqing to test the most efficient method of transmitting solar power from space to earth. The race to space, and to harness its vast energy sources, will propel advancements in technology that will end the need for the use of fossil fuels.

## Smart Cities

The future of renewable energy and ecological harmony also lies in the growth of smart cities and 5G networks. The British Standards Institute (BSI) defines smart cities as, “the effective integration of physical, digital and human systems in the built environment to deliver sustainable, prosperous and inclusive future for its citizens” (BSI, 2014). This is done by incorporating information and communication technologies (ICT) to enhance public services including utilities, transportation, energy, and air quality. Smart cities can also offer real time communication alerts for its inhabitants including pollution, weather and energy notifications. (Smith, 2018). 5th generation cellular wireless (5G networks) will enhance smart cities with greater speed to move more data, increase responsiveness and provide the ability to connect more devices at once (Segan, 2019). Some examples include real-time water sensors that can alert communities about water contamination, real-time air quality reports, and real-time monitoring of energy efficiency by monitoring peak energy loads and integrating renewable energy sources. According to the Center for Technology Innovation at Brookings, “ICT-enabled solutions offer the potential to reduce greenhouse gas emissions by 16.5 percent, create 29.5 million jobs and yield 1.9 trillion dollars in savings” (Segan, 2019).

In addition, an analysis by the Pacific Northwest National Laboratory found that a smart energy grid could reduce energy usage and carbon impact by 12 percent directly and six percent indirectly” (West, 2016). Also referred to as distributed energy resources systems (DER), DER systems use renewable energy sources versus standard coal or oil and are therefore more reliable. Smart cities can hence be designed more efficiently to reduce energy use. Furthermore, the role of A.I will enable more accurate forecasting and consumption reports. According to Stephen Woodhouse, Chief Digital Officer of Pöyry, “technology advancements in AI over the last few years, in conjunction with growth in generation from distributed renewables, smart devices and demand management services, among others, is leading to major changes in the power sector....AI will benefit immensely from the uses of that data, in terms of decision making and planning, condition monitoring, robotics, inspections, certifications, supply chain optimization and generally increasing efficiency” (IRENA, 2018).

Smart cities are not just a hope of the future, but already exist. According to the International Data Corporation (IDC), world-wide technology spending for smart cities reached \$80 billion in 2016, and is expected to grow to \$135 billion by 2021 (Maddox, 2018). Cities in the United States,

including New York, San Francisco and Chicago have already started to advance. Chicago has already installed smart boxes on municipal light poles with sensors and cameras to capture air quality, sound levels, temperature and water levels in order to offer real-time updates to its inhabitants. “The future of smart cities will involve advanced and low-latency applications that leverage big data analytics and real-time video and information sharing, enabled by 5G. Computing and storage at the edge, and fiber that goes deep into neighborhoods is critical to get cities to that point,” said Daniele Loffreda, head of market development and consulting for Ciena. Ciena, a networking services, systems and software company, is helping cities with coherent optical, edge packet platforms, automation, and multi-domain service orchestration” (Maddox, 2018). The future of the world is green, as Earth and its ecosystem will morph into an era sustainable, technologically intelligent living.

### **Waste and the Future of Recycling**

Global waste can be resolved using advancements in technology and quantum computing. According to the EPA’s *Sustainable Materials Management: The Road Ahead*, if the United States is to maintain a competitive advantage in the world’s economy, then we must find a way to become a sustainable economy by, “using less materials, reducing toxics and recovering more of the materials used” (EPA, 2007). *The Road Ahead* states that, “far more materials are being moved or transformed to meet society’s needs than most people realize. In particular, “hidden” material flows (i.e., waste) include mining overburden, earth moving, and erosion, and account for as much as 75 percent of the total materials that industrial economies use.” (EPA, 2007). More alarmingly, is the fact that hidden waste flows are not accounted for in GDP. They do, however, result in, “ecosystem degradation such as landscape alteration, loss of soil structure and fertility, stream flow changes, ecosystem disruption, and toxic impacts to land, air, and water from direct releases and leaching” (EPA, 2007). A response to the U.S waste issue includes China’s departure from the World Trade Organization in January 2018. Their departure sent countries around the world, including the U.S., scrambling to find new options for their refuse. For more than 25 years, China was the end point for refuse from hundreds of countries globally. With the U.S. leading as the number one trash producing country, the ban set by China ban forced Americans to take action on recycling and waste. The U.S. generates 40 percent of the world’s waste, equaling over 262.4 million tons. Only 67.8 million tons of that is recycled and 23.4 million tons is composted (EPA, 2018). Second behind the United States



is Russia, producing over 207.4 million tons, and Japan, producing 52.36 million tons (GreenAnswers, 2019). If we continue on this path, it will be necessary to set regulations and assign responsibilities to these global offenders for their significant contributions to the waste pandemic.

One answer to the global waste pandemic, is the creation of new recyclable technologies. This includes the creation of new solvents, including polymer dissolving salts, which will result in the full breakdown of plastics, styrofoam, glass and cardboard paper. These new solvents will turn what was once trash into reusable matter (Samsung, 2016). A second solution will be the global launch of the IBM VolCat (volatile catalyst). Introduced in early spring 2019, the VolCat process, “everything from milk cartons to cookie containers to grocery bags and cheese cloths... into recycle matter that can be turned it into something useful” (Hirsh, 2019). Discarded electronics, or e-waste, will be produced to self-destruct using heat and acid. In 2018, there was 49.8 million metric tons of e-waste produced globally (Statista, 2018). Currently being perfected by the University of Illinois, heat triggered self-destructing electronics will reduce these products into their raw materials so they can be dissolved and not sit in landfills (Barcia, 2015). Waste that is not recycled will be turned into fuel using microbial fuel cells (MFCs) (Penn State, 2019). This advancement recycling technology allows even the most complex man-made materials. MFCs uses bacteria to convert organic matter into electrical energy. It is forecasted that homes and offices will be equipped with bio electrochemical systems to house MFCs. Similar to a septic tank, the bio electrochemical systems will be used to produce electricity, gas and clean water (Samsung, 2016).

Technology has the ability to reduce food waste by 50 percent in 2040 (Future Agenda, 2019). In 2019, The Food and Agriculture of the United Nations reported that the world wastes over 1.3 billion tons of food each year (Broom, 2019). Less than a quarter of that waste could feed the one billion people who go hungry each day. Countries such as Korea led as an example of how 95 percent of food waste can be recycled (Broom, 2019). This includes the implementation of the smart food waste bins that debuted in Seoul. In a six-year trial, 6,000 smart bins reduced food waste by 47,000 tons. Waste collected in Korea’s smart bins is processed to remove moisture and turned into dry waste. Dry waste is then turned into fertilizer that drives the country’s burgeoning urban farm movement” (Broom, 2019). Winnow Vision, a smart bin produced in the United Kingdom, uses a camera and scale to track the types of food that are discarded. Having successfully installed 75 devices year-to-date, Winno estimates that it has helped restaurants reduce their carbon footprint by 50,000 tons a year (Winno Solution Ltd, 2019). Smart bins offer transparency to the amount of waste

society is generating, creating greater awareness and consciousness that will influence society to make better choices.

Further advances in the reduction of food waste include smart technological improvements to hydroponic and aquaponic farming that will result in in-home hydroponic and aquaponic kitchens. Hydroponics, the process of growing plants in nutrient rich water solution, is a soil free approach to growing food. Aquaponics, which sustains aquatic animals including snails, fish, prawns, and frogs, and uses plants in a symbiotic relationship. The benefits of having these systems integrated into homes, offices and restaurants is that hydroponic and aquaponic farming removes the need for soil, reduces water use and provides sustainable food sources. “Hydroponic farming systems can reduce water consumption by up to 90 percent compared to traditional agriculture’s water usage” (The Aquaponic Source, 2019). These systems will further recycling efforts by using recycled rain water to nurture plants grown at home (Samsung, 2019). Companies including Cloudponics, Earth Prime and Urban Cultivators have already made technological advancements in hydroponic and aquaponic farming system. By incorporating real time data feedback, temperature control and mobile apps can take the guesswork out of growing food at home (Shiffler, 2018). Additional technological solutions include using smart sensors to produce real-time records of food harvests including temperature and water fluctuations.

Blockchain offers further solutions to waste management. Blockchain technology will make tracking of the disposal of waste possible. According to Phil Rudoni, Chief Tech Officer at Rubicon, a cloud-based recycling and waste services company, “a big issue the waste industry faces is the lack of accountability for the end destination of recycled material... It wouldn’t be so difficult to design a system where pieces of plastic (or trash bags) could be tagged with scannable QR-Codes and then tracked at each step of the recycling supply chain” (Swachhcoin, 2019). Plastic Bank, a global recycling venture founded in Canada, aims to reduce plastic waste in developing countries by paying people in Blockchain-secured digital tokens. “The tokens can be used to purchase things like food or phone-charging units in any store using the Plastic Bank app. The plastic is then bought by companies and recycled into new consumer products. This system is more attractive because Blockchain’s transparency means they can see and monitor where their investment goes” (Swachhcoin, 2019). Meanwhile, companies such as Marine Transport International offer a tracking system that connects recycling suppliers, port operators and ocean carriers. “The shipping of

recovered materials is necessarily heavily regulated, and we've had a real impact in simplifying the process while remaining compliant" (Swachhcoin, 2019).

### **Sustainable Cosmetics**

Beauty and cosmetic companies are joining the cause to decrease the amount of global waste and plastic that is being discarded. This includes the U.S., Canada, New Zealand and the United Kingdom's ban of plastic microbeads in 2015, to the recent implementation of sustainable packaging and ethically sourced ingredients. A Teen Vogue article published in December 2018 cited that in 2017, the beauty industry produced 76.8 billion plastic packaging units (Westervelt, 2018). More alarming, was that this number did not include plastic accessories and applicators. According to Amy Ziff, executive director of Made Safe, a third-party certification of beauty and household products, "that's about where the hard data on plastic in the beauty industry ends. A lot of companies are working on packaging, but it's just an area that's been less scrutinized in beauty than other industries...I think it's only a matter of time, though" (Westervelt, 2018).

Global and locally recognized brands have since announced further initiatives to tackle waste and plastic issues. This includes L'Oreal and Unilever, who have teamed up with the Ellen MacArthur Foundation New Plastics Economy initiative. L'Oreal has committed that, "all of its plastic packaging will be rechargeable, refillable, recyclable, or compostable by 2025" (Westervelt, 2018). Founded in 2010, the Ellen MacArthur Foundation's goal was to establish a circular economy in order to minimize waste and protect resources. In early 2019, the Ellen MacArthur Foundation published a *New Plastics Economy Global Commitment Report*. A first of its kind, the report collected information on global government and industry efforts to reduce plastic waste in order to increase transparency. Cosmetic companies that joined the Ellen MacArthur Foundation and are included in the report include Colgate-Palmolive, SC Johnson, L'Oreal, and Unilever. In 2017 L'Oreal reported that 76 percent of its products featured an improved environmental or social profile, a number that will reach 100 percent by 2020 (L'Oreal, 2017). Unilever also commits to 100 percent recyclable plastic packaging by 2025. According to Paul Polman, Unilever CEO, "our plastic packaging plays a critical role in making our products appealing, safe and enjoyable for our consumers. It is clear that if we want to continue to reap the benefits of this versatile material, we need to do much more as an industry to help ensure it is managed responsibly and efficiently post-consumer use" (Unilever, 2017). Another up-and-coming brand, LOLI, is one of the world's first

zero-waste beauty companies. LOLI produces products that are 100 percent water-free and uses glass and post-consumer recycled cardboard in its packaging. Tina Hedges, LOLI's founder, founded the brand, "because I did not think plastic bottles, 90 percent water, and pollution and diluting ingredients was fair to the planet or people" (Westervelt, 2018). Ren, a natural skincare brand, has introduced product bottles that are produced using reclaimed ocean plastic (McIntyre, 2018). According to a recent article published on MarieClare.com, "natural is no longer enough; you need beauty products that are sustainable" (McIntyre, 2019), and our research could not agree more.

When used to its potential, technology has the ability to defend the planet from the damaging impacts of all levels of society: from individual food waste, corporate plastic waste, to entire nation's CO2 emissions. It is vital to recognize technology's power and have the knowledge to implement its capabilities to preserve Earth's resources, and more importantly, protect the future generations.

## CONCLUSION

Throughout history, technology has shown visible benefits to the human race with tangible advancements to the way we do everyday tasks. With centuries of technological advancements, we have developed technology such as Artificial Intelligence that has surpassed the common and general understanding of the human mind, therefore instilling fear and uncertainty. Theories of super AIs that overtake humans, loss of control and unforeseeably devastating end results such as those seen in media and Hollywood blockbusters is no longer science fiction. There is no denial that the explosion of technology is powerful, and with education and regulation led by proactive humans, the benefits can be fully realized by society.

In our extensive research, we have identified three areas, Data, Welfare, and Ecosystem, as the conduit that bonds technology with the welfare of our global society. We need to educate ourselves in these areas to grow into a future universe within the Fifth Industrial Revolution. The first three Industrial Revolutions were physical with advancements such as steam, electricity and personal computers. The Fourth Industrial Revolution is half physical and half cyber, giving way to technologies such as IoT and Artificial Intelligence. The Fourth is a crucial turning point as "AI will be bigger than electricity or fire" because it has the potential to fundamentally change how we do everything—significantly, because it's not subject to the constraints most resources are." (Google CEO, Sundar Pichai).

We are at an inflection point in history and nearing a moment in time referred to as Singularity. Humans are not going to become obsolete regardless of this inflection point. Society is in fact, at the forefront of seeing and guiding the future of data, welfare, and ecosystems. As we rapidly approach the Fifth Industrial Revolution, we must bring the Beauty Industry into the technological forefront with a bridge between human intelligence and machine intelligence. We have identified technological singularity happening in 2040, as when human intelligence is surpassed by the growth rate of machine intelligence. We must learn to not be fearful of singularity and adapt learning, skill sets, and advancements within the tech space to ensure Artificial Intelligence becomes a tool for beneficial societal and economic growth and not a method for anthropological extinction. A key component of avoiding fear with singularity is to be honest with consumers when a company is using Artificial Technology instead of humans in relation to consumer interaction. We must learn to use artificial technology with complete transparency to consumers. Industries as a whole must be ready with truthful answers when asked how customer data is being captured and openly shared to better meet consumer needs. With the amount of knowledge at our fingertips, the only true threat to technological advancements is global ignorance to change and fear of the unknown. While our research has proved that singularity is no longer a hypothetical theory, but a future norm, we must learn how to integrate artificial intelligence to advance society while still encourage and teach our uniquely human skills.

As brand holders, amplified voices and leaders in industry, corporations must define a strong and thoughtful strategy to ensure that the beneficial aspects of quantum computing and artificial intelligence is interwoven into overarching corporate strategies. Our research has proven that societies, such as India, are being pushed to the forefront of modern developments due to the lack of past infrastructures. More established markets, such as the United States, must work with legislators and governing bodies to ensure that we do not fall behind the curve of technological advancements due to outdated regulations and questionable jurisdiction. Without a well-defined strategy of how systematic integration of new technologies can be worked into the existing industry, the corporate sphere as we know it may cease to exist.

Society will never be equipped if the upskilling of employees of all ages are not of paradigm importance. Investing in boosting the analytical and critical thinking (innately human) abilities through training and development is imperative for our future workforce. We

recommend that corporations, educational institutions, and businesses all plan a well-developed upskilling roadmap for all employees regardless of their age. It's imperative to define a 20 years roadmap from today so that we are ready for Technological singularity in 2040. As we live longer, the growing older population still has much to contribute to the workforce, this roadmap will allow for a major shift in the way we all are currently working. It is essential that the aging population of today, continues their learning and stays fulfilled instead of experiencing dissatisfaction and work related burnout.

It is imperative that we prepare as a unified global society to ensure that we are equipped and prepared to be change leaders for the future. Regulation, solicitous ideation of new technologies and global unification are imperative to ensure that a stable society can continue to exist among rapid advancements in technology. Let us become socially responsible together. Let us not fear a time when machines outsmart humans. Let us prepare and educate ourselves from a major shift from reactive to proactive.

### **BEAUTY INDUSTRY IMPERATIVES**

We have established six tangible imperatives that will help the Beauty Industry continue to prosper and grow.

1. Implement a **data privacy credo** for all stakeholders. This entails creating a statement that goes on all marketing material and advertising platforms that explains your company or brands stance on personal data collection and consumer privacy. This is a promise between you and your consumers. Start acting on the requirements of GDPR and California Privacy act since it is predicted to roll out across the United States within the next 5 years. Every consumer data acquisition point should have transparent communication as to what data is being captured, how it is being used, and whether or not it will be shared with a third party. Implement a consumer information control interface that allows customers to delete their information whenever desired. Bank of America is an example of a company that is doing this right now.
2. Get involved in **dynamic regulation**. We are at the beginning of a serious global tech regulation discussion. "The Future Councils" meeting will occur in April 2020. The meeting will host seven-hundred top thought leaders from academia,

government, business and civil society and the organizations included in the council so far are: Henkel, P&G, Swarovski, William-Sonoma, and LEGO among others. Beauty being a multi-billion dollar global industry, should be part of these conversations. Urgently work to get a seat at the table.

3. **Get up to speed** with quantum computing. As mentioned, a Quantum computer has the ability to compute a vast number of possible solutions simultaneously—and at a speed that is far beyond anything we can imagine. Quantum computing also has the ability to undo blockchain technology. Organizations are being urged to start adopting new encryption algorithms that can withstand a quantum attack. Governmental organizations like the U.S. Institute of Standards and Technology are already working on standards for post-quantum cryptography. Prepare for a quantum future by ensuring your organizations are hiring and partnering with specialists in this area.
4. **Tech-up**, meaning: upskill employees at the same rapid speeds of advanced technological growth; everyday, business is moving faster than the day before. Since 2040 is the year we predict Machine Intelligence will outpace Human Intelligence, mid-level management needs to be upskilled now as they will be leaders in 20 years. Prior to reaching the point of singularity, it's important to implement a 3-step upskilling model similar to Google's that has been proven successful. Step one: engage in deliberate practice, step two: have your best people teach, and step three: invest in courses only when it's absolutely necessary and if they change behavior (Google). Human and intelligence may be converging however AI will not beat us in emotion. This includes the ability to create trust between customers and brands. Inspire teamwork and have empathy.
5. Strengthen human abilities that machines will never have. Help your employees experience a **cognitive-reset** to become stronger critical thinkers and problem solvers.
6. **Mobilize your teams**. Old career structures resembled vertical-lines. Today, transition to a horizontal staircase model and where working across multiple business sectors is the new and desired path to professional success and happiness. Offer internal mobility to employees by allowing them to switch roles

and responsibilities. Movement from marketing, to creative, to data science will allow employees to continue to grow, learn, and face healthy and rewarding professional challenges. If you want to increase your employee retention rate you need to allow for fluidity and career mobility. Help employees build internal formalized career paths rather than having vague career discussions that don't lead to change. Create a culture where managers are supportive, not restrictive in terms of mobility.

These tangible imperatives will help your organization and brands continue to prosper and grow. They take us from our present into our future. From now until 2040, the point of singularity, humans, machines and industries will evolve and merge together.



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