

WHITE PAPER



Revolution

PART 1: TRANSFORMATIONAL TECHNOLOGY

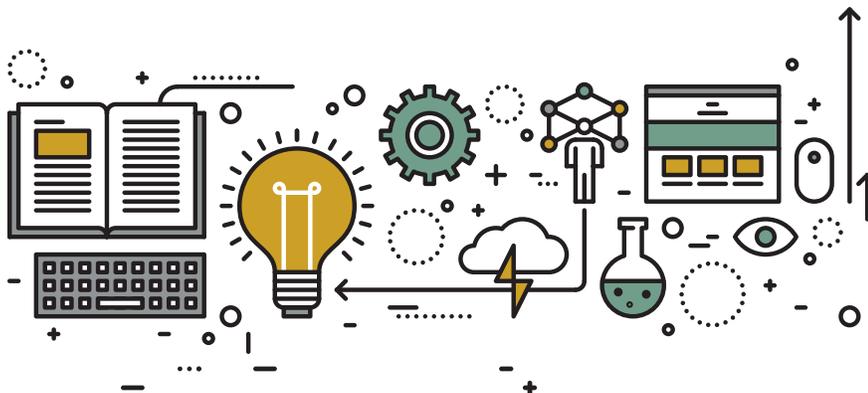
Technology is such an integral part of our daily lives that it is very easy to lose sight of the grand sweep of innovation that has taken place in recent decades, and more important, the prospect of incredible changes yet to come.



WILLIAM T. SPITZ, CFA
FOUNDER & PRINCIPAL

“You say you want a revolution Well, you know We all want to change the world”

—THE BEATLES, REVOLUTION



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Looking backward, the iPhone has more than one hundred thousand times the power of the computers that sent the Apollo spacecraft to the moon fifty years ago. The future will bring revolutionary changes in healthcare, manufacturing, business processes, transportation, entertainment, and many other areas. Even the way that we interact with the spaces and things that surround us will change significantly. The rate of technological change was already dizzying, but it has accelerated in many sectors due to the Covid-19 virus. While the prospects for a technology revolution are indeed exciting, there are also a significant number of risks and concerns, most notably cybersecurity, the disappearance of jobs in many sectors and the potential loss of privacy. Part II of this paper will focus specifically on the likelihood of significant job losses in many categories of employment.

I rate myself a barely adequate user but it is obvious that technology is one of, if not the most important factor driving Corporate America and the stock market. So, as an investor and corporate director, I decided that I needed to get up to speed; at least as far as I could go without a technology background. I read several books and digested a large number of reports from technology consulting firms and this paper shares some of what I learned. Rather than make any judgments regarding the investment merits of technology stocks, I instead attempt to gain a sense of the major trends in technology itself. Three of these trends are highlighted with brief information on the relevant technologies driving them. Next is a discussion of major risks and concerns and then a few thoughts on the impact of Covid-19. You certainly won't be a tech guru after reading this paper, but you should have a high-level understanding of where the world is headed as well the ability to decipher some of the tech buzzwords.

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Significant Improvement in the Human Condition

Some believe there will be a significant increase in life expectancy in the coming decades although it has actually declined slightly in recent years due to issues such as suicide, opiate addiction, and diabetes. However, there is virtually universal agreement that new technologies will help eradicate some diseases, improve the quality of day-to-day life for many, and expand our capability as humans. What follows is a list of just some of the exciting technologies that are either already in use or in the later stages of development:

- **Personalized medicine** - The ability to tailor drugs to the DNA of a specific individual and to create one-off drugs to treat extremely rare diseases
- **Gene editing** - The ability to modify a defective gene that might lead to disease at a future date
- **Organ manufacturing** - The creation of human organs using tissue and 3-D printing
- **Anti-aging drugs** - Drugs that may not extend life but will drastically improve the quality of life by eliminating debilitating syndromes associated with aging
- **The ability for the brain to communicate with devices.** For example, an exoskeleton that would allow a paralyzed person to walk
- **A large variety of new devices that will improve healthcare.** For example, contact lens that measure pressure in the eye and provide an early electronic warning of glaucoma. Similarly, Fitbit like devices that measure a large number of variables indicating the possible onset of an illness and automatically contacting a pharmacy to prescribe an appropriate medication. And, shirts that measure your heart rate and report any irregularities
- **Virtual and augmented reality devices** - Primarily used for entertainment to this point. But, they offer great potential in terms of training, the performance of job-related tasks, education, marketing, and even rehabilitation following an injury
- **Mapping the human brain** - Having mapped the human genome, there are now multiple efforts to map the entire brain that could both reduce neurological disorders and greatly enhance our mental capacity

While some of this feels like science fiction, a good deal of it is already a reality!



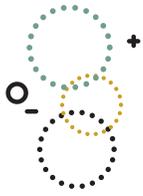
Automation

Technologies are changing our lives on a daily basis and the pace of innovation is so rapid that most of us cannot begin to imagine what is on the horizon. Automation will enhance productivity and otherwise improve many aspects of life. First, I will outline the key technologies underlying automation and then briefly describe some important applications.

- **Artificial intelligence (AI)** - The ability of machines to sense, comprehend, learn, and act with human-like intelligence
- **Machine learning** - A branch of AI in which a machine makes predictions or decisions without being explicitly programmed to do so. It trains itself by studying and analyzing data and its algorithms improve with experience
- **Natural language processing** - The ability for a machine to communicate using human speech
- **Big Data** - The declining cost of storage has led to the accumulation of the massive amount of data necessary to operate AI and Machine Learning and to conduct data analytics in a wide range of applications
- **Edge Computing** - Embedding computing capability directly in devices rather than relying on centralized capability in the Cloud. Similarly, artificial intelligence is being miniaturized so that it too can be located in devices rather than operating on a large, centralized computer
- **5G** - The newest generation of cellular networks whose speed and bandwidth allows for the interconnection of a wide variety of devices and applications
- **Quantum computing** - Devices whose speed will provide the ability to handle complex problems that have heretofore been unsolvable by even the largest computers. A Google quantum computer recently solved a problem in three minutes that the company estimates would have required more than one thousand years on the world's largest existing supercomputer

Of considerably more interest to most of us are the applications these technologies enable. Many already exist, but they will become ubiquitous and orders of magnitude more powerful in coming years.

- **Robotics** - We think of robots as machines programmed to do a single repetitive task, generally in manufacturing. However, a robot can be any form of hardware or software that takes over a human function. Non-manufacturing examples include underwriting insurance, reading an x-ray, processing paperwork, making accounting entries, preparing legal documents, conducting financial analysis, responding to email, answering telephone calls, and so on. The next generation of robots will sense and understand their surroundings, perform a variety of tasks, make intelligent decisions, and interact with humans. Those of a certain age will remember Rosie, the robotic maid in the cartoon The Jetsons. Well, Rosie will soon be with us!
- **Drones** - To date, drones have been used primarily for military operations and by hobbyists with most being piloted by a human. Many newer drones are autonomous and they will be employed in additional applications such as delivery, search and rescue, law enforcement, and even personal transportation
- **Autonomous vehicles** - Many companies are experimenting with self-driving cars. However, the more immediate application is likely to be autonomous long-haul trucks that may replace the 15.5 million trucks and 3.5 million truck drivers currently operating in the U.S. We can also expect autonomous taxis and delivery vans and are already enjoying autonomous appliances
- **Artificial intelligence applications** - Most of us already use a number of AI driven products and services including navigation guides and intelligent virtual assistants (Siri, Alexa, et al) One application that I find interesting and indicative of the near future is a smart shopper device. Imagine that you recently purchased a pair of shoes and have returned to the same department store. Your phone might signal you to walk over to a specific counter where the matching handbag is on sale. Helpful or intrusive?



Interconnection

Among all of these exciting trends, the one that may impact each of us most directly is what is known as The Internet of Things. The basic idea is that everything, and I mean everything, will be connected. The technology consulting firm The Gartner Group calls it the Intelligent Digital Mesh. Given that the Internet is in place, the requirements for this next phase of development are artificial intelligence, vast amounts of data, advanced and relatively inexpensive sensors, and high-speed communications. The list of applications is literally endless, but here is a sampling:

SPACES

- Smart spaces in which people actively engage and communicate with their surroundings. This will both increase productivity and create an immersive experience
- Smart homes-Smart phone coordination and operation of a home's thermostat, appliances, entertainment, security, etc. And, smart devices such as a refrigerator that keeps track of its contents and reorders when supplies reach a certain point
- Stores with completely automated checkout-Amazon has already opened several
- Building management systems-optimize energy consumption, increase safety and security, improve tenant experience

INFRASTRUCTURE

- Smart traffic control
- Auto toll collection
- Fleet management and optimization
- Infrastructure maintenance-diagnosis and scheduling of maintenance
- Smart cities-parking availability, environmental monitoring, law enforcement, streamline transportation, optimize utilities

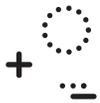
MANUFACTURING

- Advanced process control
- Predict equipment failure and schedule required maintenance
- Ability to adapt to rapid changes in demand and changes in product design
- Optimize supply chains
- Enhanced safety

CONVENIENCE, HEALTH, AND SAFETY

- Remote health monitoring
- Emergency response systems
- Sensors that monitor and assist the elderly and disabled

You will undoubtedly recognize some of these applications because they are already in use. The key turning point will be when all are connected and interactive. It won't be long!



! Risks and Concerns

Each of the following issues is highly important and deserving of an in-depth discussion. Assuming that my readers are not interested in a tome, I will only list them with a brief comment or two. For those who prefer a deep dive, I recommend **The Fourth Industrial Revolution by Klaus Schwab** who is the Founder of the World Economic Forum.

- Loss of privacy and the risk of pervasive surveillance in a world in which all things are connected
- Job losses in many sectors - *See Part II*
- Risk of insecure autonomous systems - self driving cars have been hacked
- Further growth in income inequality - knowledge jobs versus all the rest
- Interdependence of technologies - systemic vulnerability?
- Manipulation of artificial intelligence - remember Hal in 2001 A Space Odyssey?
- Bio ethics - for example, the use of gene altering techniques to create bespoke babies
- Ability of governments to manage the implications and complexities of these technologies
- Cybersecurity
- Decline in interpersonal relationships and social isolation

Personally, my greatest concern is the ability of governments to function in this new world. Having said that, I come down on the side that these risks are no more severe than those faced in the three previous industrial revolutions (Steam, electricity, computers) and I am hopeful that our corporate and government leaders will address them in good faith.



Covid-19

It is too early to tell whether the Coronavirus has stimulated any new technologies, but it is clear that it has accelerated a number of trends that were already in place. Specifically:

- Growth in on-line shopping and development of robotic delivery
- Growth in digital/ contactless payment mechanisms
- Growth in remote work-further development of virtual private networks, etc.
- Growth in distance learning
- Growth in telemedicine
- Growth in on-line entertainment
- Substitution of AI for human jobs

Nine months into the pandemic, these seem so obvious but many were barely on our radar screens prior to 2020. Even as we find effective treatments and a vaccine, it seems highly likely that these trends are permanent.

Most of us have neither the capability nor the interest to dig into the details of emerging technologies but we should all understand the major trends that will materially change our lives. Accordingly, this paper focuses on overriding themes, the most important of which are artificial intelligence, automation, and the ubiquity of data. They will change the way that we live, work, and play, and most of us will be surprised at how quickly it occurs.

Some people are generally uncomfortable with change and others will be hyper-focused on the risks cited above. I too am aware and concerned about some of these issues. However, I say bring on the revolution; it is an incredibly interesting and exciting time to be alive!

“Science and technology revolutionize our lives, but memory, tradition, and myth frame our response.”

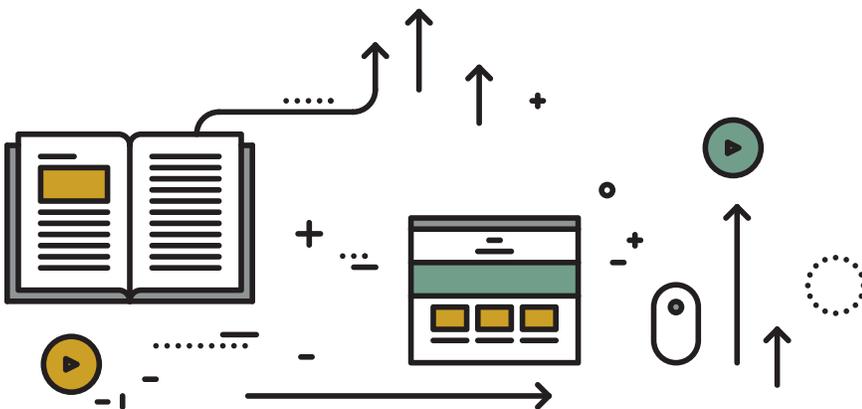
— ARTHUR SCHLESINGER NOTED HISTORIAN

PART 2: THE CHANGING NATURE OF WORK

One of my great disappointments is the failure of our government to take any serious steps to deal with what is likely to be a massive job dislocation due to new technologies. This is not a partisan statement in that this problem has been developing for a long time.

Estimates vary as to the number of jobs that will be lost, but a number like 30% is very common which amounts to almost 50 million people in the U.S. alone. A McKinsey report from 2017 estimated that 400-800 million jobs could be automated worldwide, and other experts place the number as high as one billion. It has been suggested that this shift is analogous to the transition from agriculture to manufacturing that took place early in the 20th century. Most economists suggest that new industries will be created by automation, but there is significant disagreement as to whether the newly created jobs will be sufficient to overcome losses. Moreover, efforts to retrain workers are episodic and uncoordinated and there are serious questions as to whether many older workers can be retrained at all. As just one data point, the Bureau of Labor Statistics indicates that one in three workers who lose long standing jobs is not reemployed. Among those who are able to find new jobs, more than one-third take at least a 20% pay cut versus their prior position.

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What Kinds of Jobs Will Be Impacted?

Basically, jobs that are rules-based, repetitive, or low skilled are at risk. Among the more obvious categories are: sales clerks and cashiers, data entry, bank tellers, food service cooks and hostesses, fast food point of sale positions, short and long-haul trucking, receptionists, secretaries, administrative assistants, warehouse workers, some manufacturing positions, telemarketers, machinery operators, and a variety of inspectors and process control positions. To provide a little context, there are 3.5 million truck drivers in the U.S. and 29 million people directly engaged in retail. These two categories alone represent 20% of the U.S. labor force.

Perhaps somewhat surprisingly, a number of white-collar jobs are also deemed vulnerable. The fields most often cited are accounting including bookkeepers and auditors, paralegal, insurance underwriting, insurance claims adjustors, loan officers, financial analysts, and even radiologists and pathologists.

The jobs least likely to be automated are primarily involved in human services that require interpersonal skills and empathy as well as those based on creativity and imagination. Examples include occupational therapists, many types of doctors, nurses, and dentists, social workers, teachers, writers, and computer system analysts and engineers.



Scope of the Problem

As previously mentioned, there is considerable debate on the size of potential job losses, the number of new industries and jobs created due to automation, and the long-term impact on the economy. Here are some interesting tidbits that do not answer these questions but provide context and perspective:

- There are 3 million manufacturing robots in the U.S. today and the number is growing at 14% per year. China is expected to have as many as 14 million by 2030.
- Some economists estimate that more than 40% of the jobs lost in the pandemic will never return.
- The most valuable company in 1964 (AT&T) employed 758,000 people. The most valuable company today (Apple) employs 137,000.

- In addition to lost jobs, perhaps 50% of remaining employees will require retraining in the next ten years.
- The World Economic Forum predicts that 75 million jobs will be lost but 133 million gained in new industries. Other economists aren't so sure.
- Most economists expect significant improvement in productivity due to automation that could lead to as much as a 15% increase in GDP. The question is how the pot will be divided.
- All levels of government are concerned about lost revenue since robots do not directly pay taxes.

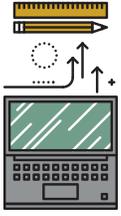


Sociological and Geographic Considerations

There is general agreement that those with lower levels of education will be most impacted. Specifically, 40% of job losses will be experienced by those with less than a high school diploma since they are frequently employed in occupations particularly at risk of automation. Similarly, 29% of workers in the 16-24 age group are employed in food service although they only represent 9% of the overall labor force.

The expected impact with regard to gender is mixed. Males employed in some construction and manufacturing jobs are at risk as are those in trucking, warehouse operations, and so on. Women employed in office clerical positions, sales, call centers, retail, and food service are also vulnerable. On the other hand, women are disproportionately represented in healthcare and education that are among the safer categories.

Finally, the impact is expected to be most acute in the heartland since educational attainment is generally lower than in the coastal gateway cities. For example, in some rural states, only 25% of adults possess a college degree.



Retraining

The obvious solution to the trend toward automation is a massive retraining effort but the U.S. currently spends public funds equal to only .1% of GDP, less than one half of what was spent thirty years ago. Similar trends are apparent in other OECD countries and there has been no significant upswing in corporate training budgets although Amazon's 2019 announcement that it will spend \$700 million on employee retraining suggests that may be changing.

It is highly unlikely that either government or Corporate America can solve this issue in isolation and that parallel, and intersecting efforts will be required. Two good examples of public/private partnerships are a program in which Swedish employers pay into private funds that provide financial assistance to employees enrolled in retraining and a policy in which the Government of Singapore reimburses citizens for approved training courses.

Some have suggested that we need a massive government program analogous to the Marshall Plan or the GI Bill. Rather than start from scratch, one solution is to significantly expand the Trade Adjustment Assistance Program which provides retraining among other benefits to those who have lost jobs due to shifts in production related to trade. In addition to training programs themselves, a successful plan would require many other features such as income assistance and support services including child care, transportation, and relocation. Of course, a major question is the source of funds to pay for such a program. The World Economic Forum estimates that it costs about \$25,000 to retrain an employee. When multiplied by as many as 50 million employees, this calls for \$1.25 trillion in government support. While such a number would have been unthinkable until recently, the \$3 trillion that has been spent on Covid-19 related stimulus suggests that funds could be found if our leaders were convinced of the importance and immediate need of such a program. Two mitigating factors to the

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cost challenge could be the significant increase in the number and quality of on-line courses and the potential use of the more than 1600 community colleges in the U.S.

An opposing point of view is that government programs are not effective because they are too far removed from actual job requirements. This group argues that the answer lies in corporate run programs, perhaps subsidized and supplemented by government income maintenance and support services assistance. A 2017 survey by McKinsey found that by a margin of five to one, executives believe corporations must take the lead in retraining and “upskilling” their employee base. Unfortunately, only 16% felt their company was prepared to deal with the challenge and they expressed two primary concerns. First, they admitted to not having a true understanding of the impact of automation on the skill requirements for their employees. Second, many felt they did not have the appropriate HR infrastructure to conduct massive retraining. However, the majority realize that retraining employees to increase productivity is a business imperative due to competitive pressures.

In conclusion, it seems to me that the first step is to accept the immediacy and size of the problem, and I find it very disheartening that it is not central to the current political discourse. Once the threat is widely understood and accepted, some blend of public and private effort should be able to retrain a significant number of the vulnerable portion of the workforce. Perhaps 15-20% of vulnerable workers cannot be retrained profitably which will require a transition to retirement with an appropriate safety net. In either case, we have the knowledge and capability so all that is required is the will.

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