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RESEARCH UPDATE

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THE FUTURE OF WORK

By: Brian Colbert

The Future of Work

In today's society, one's career is practically synonymous with their identity and shapes who they will become. A job provides income, establishes social status and offers opportunities for personal and professional growth. It is easy to see how it has become a significant part of one's self-image and identity.

Yet, the traditional 'job' is evolving, in many ways. Several technological trends will alter the quantity, nature and ultimate purpose of jobs. Automation is top-of-mind for most, yet other rising technologies such as Virtual Reality (VR) and the Internet of Things (IoT) will also have profound effects that profoundly shift the nature of work.

Automation: The Big Question

In its broadest sense, automation is the use of technology to perform tasks typically performed by humans (Merriam-Webster, n.d.). Automation has sparked a dramatic upheaval in the nature of work before. During the first Industrial Revolution, automation in the form of steam-powered machinery shifted employment from leisurely, mainly agricultural operations conducted alone or in small teams to factory work done in far larger teams. The second Industrial Revolution shifted the focus of work again, from dirty and difficult factory work to more intellectually demanding, labour light. This third Industrial Revolution, of which we are currently at the outset, promises to reshape work more dramatically than any before it.

It's easy for most to imagine machine labourers getting stronger, faster and more efficient than humans. Yet the third Industrial Revolution rests on the idea that machines can also "think" or perform complex skilled work, which previously was exclusively in the human domain. Artificial Intelligence and its related technologies (AI) drive this change, and progress in the field has occurred at an astounding pace. In its current state, AI can do everything from driving vehicles (link to demo) to parsing legal documents to diagnosing cancers. It can do this all at a greater speed and accuracy than its traditional human counterparts.

What does this mean for the nature of work? Eventually, every profession will be touched by this revolution, many to great extents. A 2018 McKinsey report finds that 50% of current work activities are automatable with today's technology, representing 30% or more of the activities required in 6 out of 10 occupations (Manyika & Sneader, 2018).

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The effects of automation vary across these professions, ranging from full displacement to massive productivity improvements. Jobs that are routine, repetitive and predictable in nature will be the first to be fully automated; think telemarketers, loan officers and bookkeepers. Analysts estimate that these jobs are all over 90% likely to be automated in the next 20 years, with an overall global displacement of ~400 million workers (Mahdawi & Chalabi, 2017). However, jobs that involve creativity, building relationships and unpredictable work such as social workers, occupational therapists and front-line mechanics, are largely safe (for now). In the middle of the spectrum, which covers most professions, certain repetitive tasks will become automated to enable employees to work on more value-added activities.

To examine what this means on a deeper level, let's look at how automation will affect two highly-coveted jobs in the Commerce space: investment banking and management consulting.

Investment Banking

At the senior levels, investment banking holds plentiful allure as a profession. Working with some of the largest clients in the world to raise capital and advise on mergers and acquisitions is high-paced, intellectually engaging and relationship-oriented. However, at the junior levels, much of the job is indeed repetitive, repeatable and predictable: hardcoding numbers into Excel, updating PowerPoint slides, and the like.

AI has the potential to step in and automate much of this grunt work. Global investment bank *Goldman Sachs* has spent the past two years creating Jupiter, a system designed to automate segments of the initial public offering (IPO) process, assess activist threats and model the impact of a merger on a company's financial performance. *Barclays* has a similar AI-based tool that values potential acquisition targets for its clients (Clarke, 2019).

Managing Directors and Vice Presidents, whose roles are primarily relationship-oriented, will likely not see their roles change significantly. However, Analysts and Associates, whose roles are primarily analysis-oriented, will be significantly affected. In short, there will be fewer roles available, but for those with a job, the work will become much less mundane. Adrian Crocket, a former Managing Director at *Credit Suisse*, believes that Analyst classes will shrink by 30% in the next five years.

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Yet, other bankers believe that it will simply free up junior analysts to contribute more to collaborative and highly impactful opportunities. Industry experts, such as Ronald Jansen from *UBS*, believes that most junior bankers will not only need business knowledge, but mathematical and programming skills in the next 5 years as well (Clarke, 2019).

Management Consulting

Management consulting, another corporate advisory role, is in a similar position. While partners and engagement managers have relationship-oriented, creative and genuinely unpredictable roles, much of an analyst's job boils down to slide preparation and analysis. From a pure productivity standpoint, it's hard to argue that these tasks can not and will not be automated. A 2017 *Harvard Business Review* article summarized it well how "the processing power of four smart consultants with Excel spreadsheets is miniscule in comparison to a single smart computer using AI running for an hour, based on continuous, non-stop machine learning" (Libert & Beck, 2017). Industry leaders are already taking steps to automate consultant tasks. *Harley-Davidson*, for example, uses AI to determine the effective and ineffective components of its marketing channels and inform resource allocation decisions (Libert & Beck, 2017). It's difficult to argue that consulting as a profession is at risk of extinction, but like investment banking, junior roles will need to change significantly both in quantity of positions and the nature of the work in the coming years.

In aggregate, automation will likely make employment more creative, collaborative and social. For most jobs, it will automate repetitive and analytical tasks largely conducted by junior level employees. Others, which are primarily relationship-oriented or unpredictable, will largely remain untouched. Finally, a smaller but not insignificant portion of professions will be completely automated, creating a public policy challenge unparalleled in modern day history.

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VR & AR Applications

As recently as two decades ago, virtual reality systems were clunky, expensive, and not to mention genuinely unrealistic. Today, these systems have become portable, cheap and effective. Oculus, High Fidelity and others have developed devices able to create essentially life-like simulations that users can interact with. As advances in this field continue to gain speed, organizations will integrate this technology to deploy more effective training, improve remote working and augment worker capabilities.

Corporate training often suffers from a lack of interactivity. Even large organizations primarily use outdated lectures and pre-built modules to complete the onboarding process. While these solutions are adequate, virtual reality can revolutionize this training by making it real-time, memorable and interactive. Early VR adopters have seen learning retention rates as high as 75%, compared to 10% for traditional methods, as well as training times shortened by over 40% (Wakefield, 2016). *STRIVR*, a learning immersion company, has worked with *Walmart* to train its retail associates, *Verizon* to teach employees how to handle dangerous situations, and other companies such as *Fidelity* and *jetBlue* on various projects. Soon, most new entrants into the workforce may well be expected to complete a series of VR modules before they start their jobs. This will likely make employees more productive, safe and knowledgeable, improving the nature of work overall.

A confluence of factors has led to the growth of remote work: new employees are demanding more flexibility, companies are becoming more global, and office space is becoming increasingly expensive. Today, nearly 45% of Americans work from home regularly (Chokshi, 2017). Virtual reality will only accelerate this trend. Technology giants such as *Facebook* are working on virtual reality chatrooms, in which participants can interact with each other in real-time and multiple dimensions (Patel, 2017). This makes it possible for out-of-office participants to interact in ways previously unimaginable, greatly increasing the appeal, feasibility and effectiveness of this type of work.

Augmented reality, virtual reality's not-so-distant-relative, will also dramatically affect work, guiding workflow and increasing productivity. *GE Aviation* already employs augmented reality and smart glasses to overlay manufacturing instructions and explanations for difficult to understand processes.

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This has allowed mechanics to work 8 to 12% more efficiently throughout the day and removes the need for them to check reference manuals (Schatsky & Kumar, 2018). In the future, job-applicable information will never be further than your range of sight.

IoT & Weables

While commonly thought of as a connector of gadgets and machines, the Internet of Things has the potential to connect humans to computer systems at previously inconcievable levels. This has the potential to make work safer, yet may in turn remove significant autonomy from many employees.

The Industrial Internet of Things (IIoT) is already making some of the most dangerous jobs much safer through continuous monitoring of worker health and taking preventative measures in dangerous situations. For example, trash and recycling collectors have a fatal injury rate of 34.1 per 100,000 workers, making it the 5th most dangerous job in the United States (Johnson, 2017). *Nation Waste*, one of the largest commercial waste disposal companies in the United States, implemented IIoT into their workplace to reinforce their priority on safety. The system consists of accelerometer, heart and heat sensors incorporated into a worker uniform that provides real-time data about potential hazards: sudden vertical movements, high temperatures, unusual heart rates, or unsafe areas. It notifies wearers with vibrations, alarms and flashing lights to ensure they are aware. The system is also integrated with IBM Watson, which uses machine learning to create insights on predictive protection. Overall, the system promises to reduce injuries and associated costs by 60% in the coming years and will be rolled out commercially soon (IBM, 2018).

Yet this improved safety has a cost, these systems collect significant amounts of data, much of which is personal and highly confidential. This raises considerable concerns around the corporate usage of this data. Companies will now be able to watch their employees to an unprecedented extent, which could lead many employees to feel less autonomous and more monitored in their work. This data may also be used by other stakeholders. Imagine if insurance companies could reach into internal company databases, look at individual wearable data, then charge premiums based on the information received. Most would consider this a gross violation of privacy, but this and other misuses may be a possibility if IoT becomes widely adopted in the workplace.

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Advancements in Artificial Intelligence, Virtual and Augmented Reality will make work in the future safer, easier, more flexible and more creative. However, these benefits will only apply to the workers who are able to maintain a job, a group which will almost certainly decrease over the long run.

As more jobs fall under the widening umbrella of automation, our conceptions of jobs will change dramatically. For one, the notion of a "job for life", which is already fleeting, will become a notion of the past. As entire professions become redundant by the thousands, every person entering the workforce will need to prepare for lifelong learning and several significant pivots within their career paths. When, inevitably, a majority of jobs become automated, the job will likely change from a central tenant of a person's being to a secondary consideration. Identity will become increasingly tied to personal character, skills and experiences rather than traditionally accepted achievement. Depending on how you view it, this future world has the makings to be a dream or a nightmare.

THE FUTURE OF CITIES

By: Tim Tham

The Future of Cities

In recent years, urban living has experienced significant change. Disruptions in the typical city-dweller's life style have made daily life increasingly convenient and connected. People today are accustomed to having nearly all their needs met within a few swipes and expect that innovators will identify and solve any needs that aren't yet met. With the series of innovations that have sparked many of the changes seen over the past decade, comes an equal amount of challenges left to address.

External Factors

One of the greatest forces of change will result from demographic shifts currently impacting the labour force. While cities and countries alike have been able to attribute almost 60% of their GDP growth to an expanding labour force in the past, they will need to adapt as global population growth stagnates and elderly population increases. In Western countries, we are already seeing talent pools rapidly decline. In the next 10 years, over 60% of cities in developed regions and 47% in developing regions will have less employable talent than they do today. As this talent pool withers, cities will have to attract new businesses and people with more efficient, livable infrastructure. (McKinsey, 2018)

The second force affecting cities is the increasing level of global migration. Cities are moving away from local Cosmopolitan areas into important international hot spots. Globalization is an ongoing theme that has great economic implications. Global flow of services, goods, and people could contribute up to $450 billion year-over-year to global GDP, which is up to 25% of total output (McKinsey, 2018) Developed countries and their already well-established international cities will benefit the most. These cities include Dubai, London, Hong Kong, and New York but much opportunity for new international 'nodes' still exists. Future cities will seek to tap into this international market through both progressive policies and investments infrastructure.

Another ever-present motivator for innovation is the chronic stress placed on essential resources such as water and food supplies. Resource constraints are an imminent threat as population continues to grow. Water and energy demand in cities across India, China, Africa, and the Americas are expected to exceed supply by as soon as 2030 (McKinsey 2018). These constraints are also further magnified by the increase in weather-related catastrophes witnessed across coastal cities. The number of natural disasters between 2010 and 2014 is comparable to those between 1980 and 1991. Moving forward, several barriers stand in the way of properly addressing these challenges. Poor governance, growing wealth inequality, and youth employment have made change more desirable and even less attainable.

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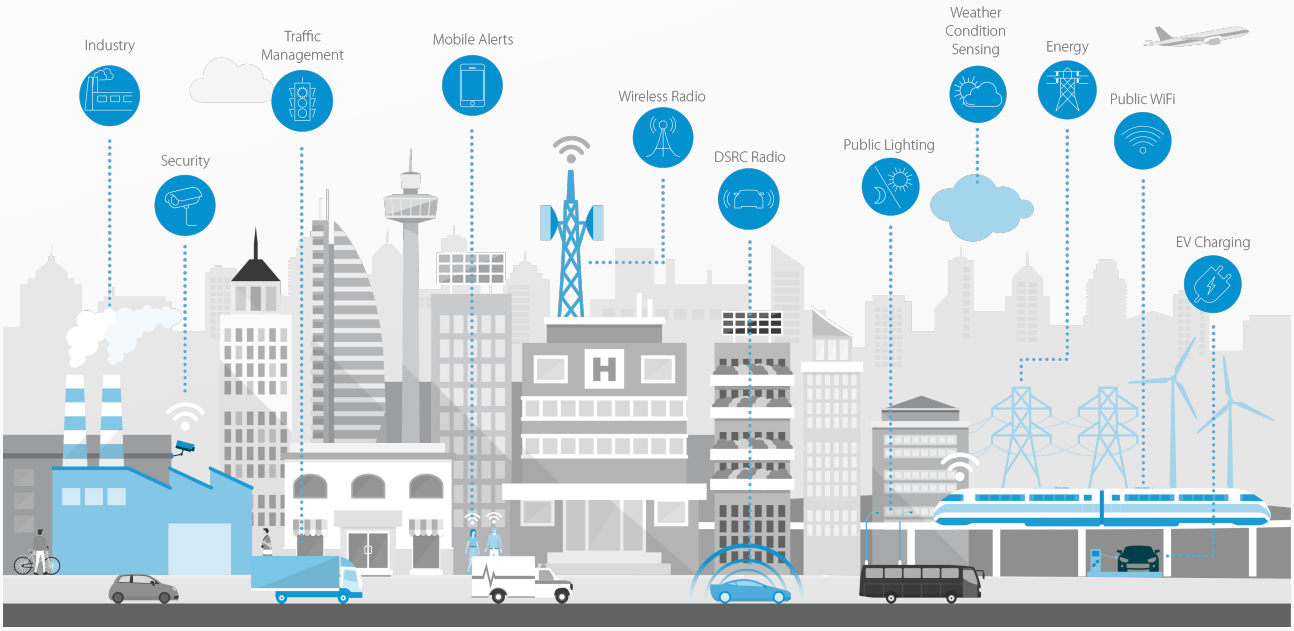
The final catalyst for change has arisen out of a new generation of technology. Digital platforms and the 'Ubers' of retail have created a rise in urban mobility. From ride sharing to smart parking, the sharing economy is only one example of technology's impact on day-to-day urban living. This sector alone is expected to grow at around 35% year over year (McKinsey 2018). Other promising areas such as cleantech are moving cities toward the a circular economy, in which technology is used to fully optimize resource use and address the aforementioned resource constraints, are getting closer to a mass-adopted reality.

Smart Cities

Broadly defined, a smart city is an urban area that uses IoT, analytics, and numerous other technologies to better manage citizens, devices, assets, transportation, and virtually every other aspect of urban living. Many of these technologies are already being deployed in isolation across several industries. In the automotive industry, for instance, Tesla has used IoT and AI to remotely modify its products and provide customers with improved functionality in real-time. These smart devices have also entered the everyday consumer arena, most notably through the adoption of smart assistants – think Amazon Alexa, and Google Home. However, a fully-envisioned smart-city goes far beyond what is conceivable today, aggregating intermediated technologies into an ecosystem of technology illustrated below:



The Future of Cities

Relevant Technologies

Smart cities will be powered by a series of enabling technologies, but the center of focus is on the Internet of Things (IoT). At the center of the illustrated technologies, IoT carries the role of aggregating, processing, and interpreting the information generated by smart devices. That is, IoT acts as the connective force between various city infrastructures. Certain major tech companies have already begun promoting their own smart city IoT applications. For instance, Microsoft outlines four key uses of its technologies. In natural resource management, IoT optimization in fields from ranging energy to agriculture. In urban areas, IoT regulation of emergency responses. In smart buildings and field services, IoT can be used to increase efficient operations of lighting, heat supply, and any other trackable units. Connected to IoT are the three additional technologies that will be critical in a smart city:

5G

The next generation of networking will bring in much needed bandwidth to perform countless complex wireless operations. Fundamentally, 5G technology will reduce latencies to make real-time connections even faster. Currently, innovation with 5G is being spearheaded by leading telecom infrastructure developers such as *Intel*, *Qualcomm* and *Cisco*. In Asia, this initiative is primarily being spearheaded by *Huawei*.

Cloud & Edge Computing

Smart cities will rely on and produce significant stores of data. As such, the cloud infrastructure could serve as the primary computing and information storage system for all core services.

Analytics & Open Data

The analytics and insights derivable from data at this point is self-evident. However, an interesting new trend in the space is the Open Data movement, which refers to public policy that opens public agency data sets and makes them publicly accessible. The opening of this data represents greater transparency and widening sets of information that will be available to all city related operations.

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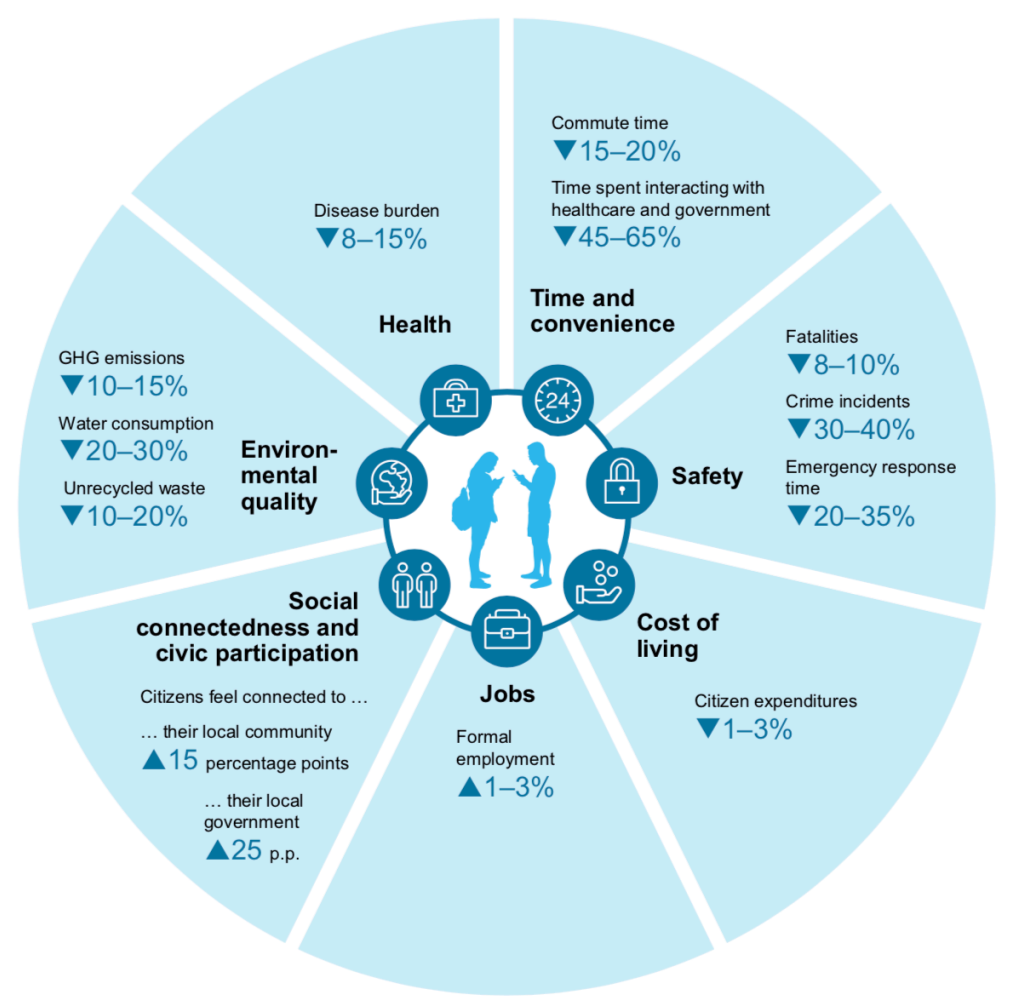
Progress

Recent experimentation and progress have begun pushing smart cities out of concept and into practice. A recent McKinsey report on smart cities has also pointed to the magnitude of change possible. Quality of life, as assessed on the following areas, could improve by somewhere between 10-30% (McKinsey, 2018)



SOURCE: McKinsey Global Institute analysis

The Future of Cities

North American and Asian cities are currently at the forefront. New York, Los Angeles, Singapore, Shenzhen, and Seoul have all begun rolling out smart city applications. E-hailing services, facial recognition security, health tech, and smart grids have all already become the norm. However, more invasive digital solutions have yet to make their ways into Western countries. Citizens have legitimate concerns about the direction and intent of smart city applications. New facial recognition and surveillance technology have painted what many to believe a dystopian, Orwellian-like future. As such, buy-in has been a major barrier to progress in the West. Overseas these concerns, common or not, have had little impact. In China, new city infrastructure has been the foundation of their new social credit system, a ranking system that monitors citizen behavior to assign or deduct "social" credit. This system has allowed China to more precisely punish citizens by banning them from transportation services, throttling internet use, barred school admission, and publicly denouncing them for misbehavior.

Although there is a very compelling ethical argument against such a system, the technology behind is certainly a testament to what is possible today. In other areas of China, the benefits are more clear. *Alibaba* has used what it has dubbed the "City Brain" to analyze real-time information from street cameras and GPS. Through the use of AI, Alibaba has been able to shorten commutes and increase first responder arrival speeds in Hangzhou. Yet these innovations do not stop there, China expects to begin moving onto tackle the water shortage challenges identified earlier. China's efforts have also had residual benefits on surrounding nations. Kuala Lumpur, Malaysia has begun implementing similar infrastructure and others are expected to follow. In Canada, smart cities may also arrive sooner than expected. Toronto expects to begin improving transit, traffic, and water use. In other areas, the city also hopes to advance civic issues with its commitment to open data (City of Toronto, 2018).

Going forward, a fully envisioned smart city will be driven by the smartest governments. Asian countries face the most immediate population concerns and their governments have effectively taken the wheel as a result. Although deliberation over the many privacy and cybersecurity issues of the digital world is certainly necessary, it has also been a significant barrier to progress. Many of the problems facing countries and their cities require immediate solutions. That being said, it's important to recognize that progress towards smart cities, or the inevitable trend toward greater digital infrastructure, should be seen as a necessity rather than a pipe-dream concept. How this progress unfolds over the next several decades will be closer to home than some people think.

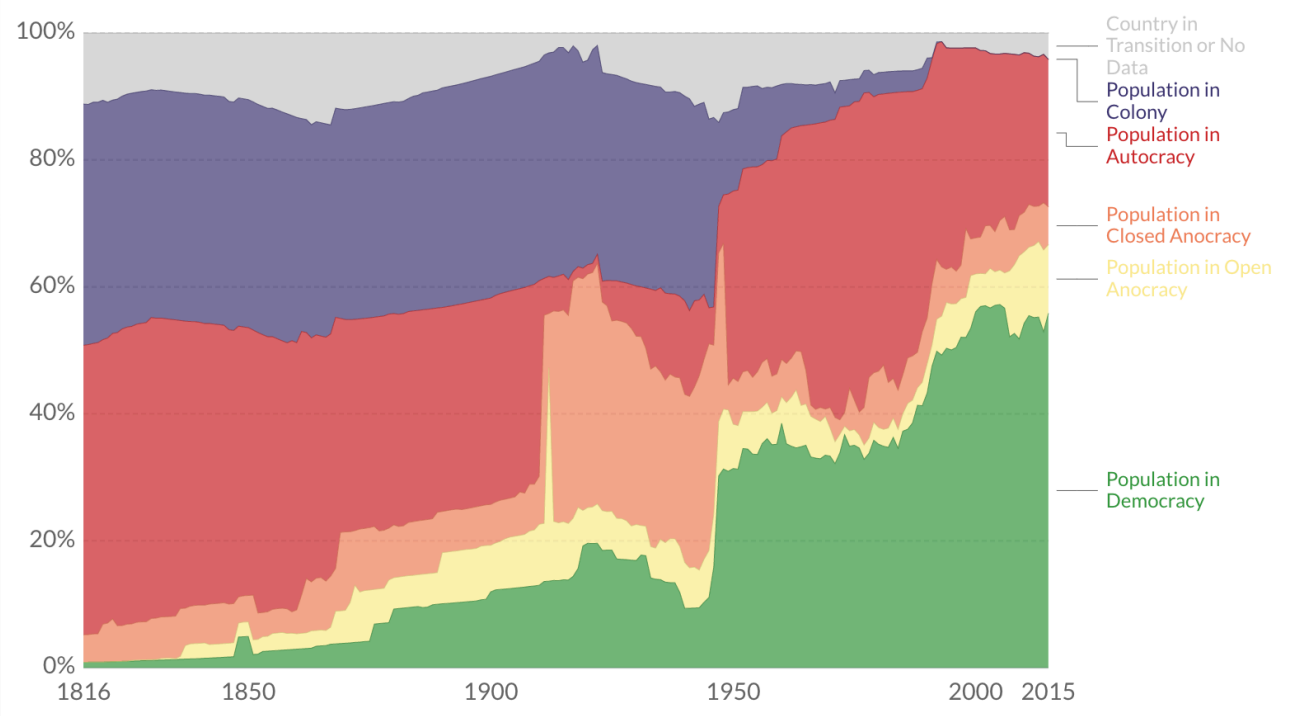
THE FUTURE OF VOTING

By: Ehsan Merati

The Future of Voting

Democracy: An Evolution

Democracy is a system of government by the whole population or all the eligible members of a state, typically through elected representatives. As can be seen by the graph below, democracy as a system of governance has proliferated across the globe, with the implicit message of liberty promulgated throughout the increasing share of the global population living in democratic nations.



Despite this admirable trend, democracy has not flourished without hiccups, and recent electoral scandals remind us that we have not yet achieved the ideal state of democracy, in which each member of a state has equal say in the governance of their livelihoods. However, the emergence of new technologies such as Blockchain, Artificial Intelligence, Social Media, and Cybersecurity seem to promise a future free of electoral fraud and the escalation of electoral transparency and integrity.

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Perhaps even, a day is approaching where direct democracy will be made possible, in which people can vote on every element of their governance on a computer directly from home, without the need for elected representatives with specialized knowledge. Shifting attitudes towards democracy have instigated the consideration of alternative voting systems, such as ranked-system voting, two-round voting, and the elimination of the electoral college in the United States. These shifts in attitude represent a possible new democratic frontier on which an educated and prosperous society can flourish. The antithesis to this optimistic future is one where these same technologies are employed in far less benevolent ways. These aforementioned technologies have enabled malevolent actors to spread propaganda and fake news at unprecedented rates, hack into voting machines, and employ mass social surveillance.

The current state of voting differs from jurisdiction to jurisdiction, even within national borders. Internationally, the most popular method of voting is by using paper-based ballots to submit selections, which are then manually tallied by volunteers or election officials. Another increasingly popular method of voting is machine voting, where votes are submitted on electronic or lever powered machines, that then tally votes automatically. In some nations, even online voting is permissible, with Estonia being the trailblazer for this method of voting in 2005.

Despite the popularity of the aforementioned voting methods, each have their flaws and potential areas of exploitation. Machine voting is vulnerable to faulty calculations and rigging, online voting is vulnerable to blackhat hackers, and manual voting is completely dependent on the people counting the votes, and a lack of transparency and supervision can make the counters act in self-interest at the expense of democracy.

Voting is essential to the fabric of a functioning democracy, and even though this topic is not often discussed in the context of technology, the intersection of the two is a paramount topic nonetheless. This article aims to analyze key technologies that are transforming processes across industries, and specifically how they can possibly transform the highest civic duty, for better or for worse, voting. The technologies in particular that will be examined are blockchain and mobility, and artificial intelligence and social media.

The Future of Voting

Blockchain & Mobility

Virtually every contemporary election flaw suffers from two root issues: a lack of transparency and centralization. Who gets to choose who's eligible for voting? Who gets to count the votes? Who gets to verify the votes? Unfortunately, the modern voting system relies on trust, as it is simply impossible for everyone to watch and certify election results. However, a promising new technology might just solve this issue, and it is called blockchain. Heard of it?

A blockchain is a growing list of records, called blocks, which are linked using cryptography. Each block contains a cryptographic hash of the previous block, a timestamp, and transaction data. By design, a blockchain is resistant to modification, as it is an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way[6]. Just from the definition, it is clear that blockchain can be used to solve modern voting woes. But just how exactly would this work?

The first element of voting could not be solved with blockchain, as voter registration necessitates a centralized list of every constituent in a given jurisdiction. Once a voter registration agency determines that someone is eligible to vote, they would receive a token or key that would allow them to vote exactly once. This is the same mechanism used to ensure that the double spending problem does not exist, but now with voting. This process could begin with every citizen using some kind of smartphone or computer to enter personal identifiable documentation to a centralized authorized server, wherein a picture is also taken, and machine learning would determine the similarity of the face to that of the document holder. Schools and libraries can remain open on the day of an election, in order to ensure that everybody has access to a device fitted with a camera. Once the registration process has culminated, the actual voting process can begin.

The actual voting process comprises of multiple steps. On the day of the election, each candidate will be given an account on the blockchain, with an "abstain" account also created for abstained votes to be sent to. On election day, each citizen logs into an authentication server using the same account login information created in the registration step, with an image taken of the user to ensure that it is indeed the same user as the one who registered. Not only can machine learning and AI detect minute differences between pictures taken during voting and registration, it can also detect fear, which can allow the system to reject any vote placed during a period in which the AI detects potential "voting under duress". Once the user has successfully logged in and placed their vote, a public key would be created and sent to the authentication server, which then associates the public key with the voter's user info.

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This voting system allows for several phenomena to occur. Firstly, every citizen of a given nation could vote from home, and therefore those who are immobile can vote with greater flexibility. A significant reason for why certain marginalized groups are underrepresented during elections, is due to the fact that they do not have the time nor the resources to make it to a polling station on the day of an election[7]. The proliferation of mobile devices allows people to vote with greater ease from home or work. Additionally, it also enables a transparent verification of voting to occur, as a public and un-alterable decentralized ledger can always be referred to and analyzed, in order to ensure that conclusions are drawn accurately.

As emerging technologies persist in enabling users to use alternative biometric information to self-identify, mobile voting systems can also incorporate these biometric trends, consequently becoming more and more accessible, as the ability to vote with a fingerprint and the glance of a look could encourage more voting, ultimately enhancing democracy. Additionally, the user interface of the voting platform is also imperative, as it is integral that no potential framing heuristic can come into play during the voting process, as a voter UI that encourages voters to vote for a certain candidate could deter the entire goal of a mobile voting platform.

Social Media & AI

In the presidential election of 2016, Russian agents seeking to wreak havoc and instigate societal divide were successful by metastasizing fake news. Even today, the world's largest democracy heads to elections in the coming weeks, and India's population is increasingly seeing the proliferation of fake news on WhatsApp, the nation's most popular social media application. How can companies such as *Facebook* deter malicious actors from leveraging their platform to deceive people across the globe?

The sheer amount of content generated today renders human filtering impossible. The only hope is automating the detection and neutralizing of fake content. In a research report titled Hierarchical Propagation Networks for Fake News Detection, researchers looked at how fake news moves through networks to see if it is distinguishable from how real news is distributed.

The researchers, from Arizona State and Penn State, used the FakeNewsNet data repository and modeled the links between real and fake news, including tweets. They analyzed the resulting network graphs, and discovered that there are, indeed, significant differences between how real news and fake news spread through social networks.

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Metrics cover such macro structural issues as tree depth and number of nodes, as well as temporal issues such as the time difference between the first tweet and the last retweets. The micro level of user conversations includes metrics such as how long a conversation tree lasts, as well as the sentiment expressed in retweets.

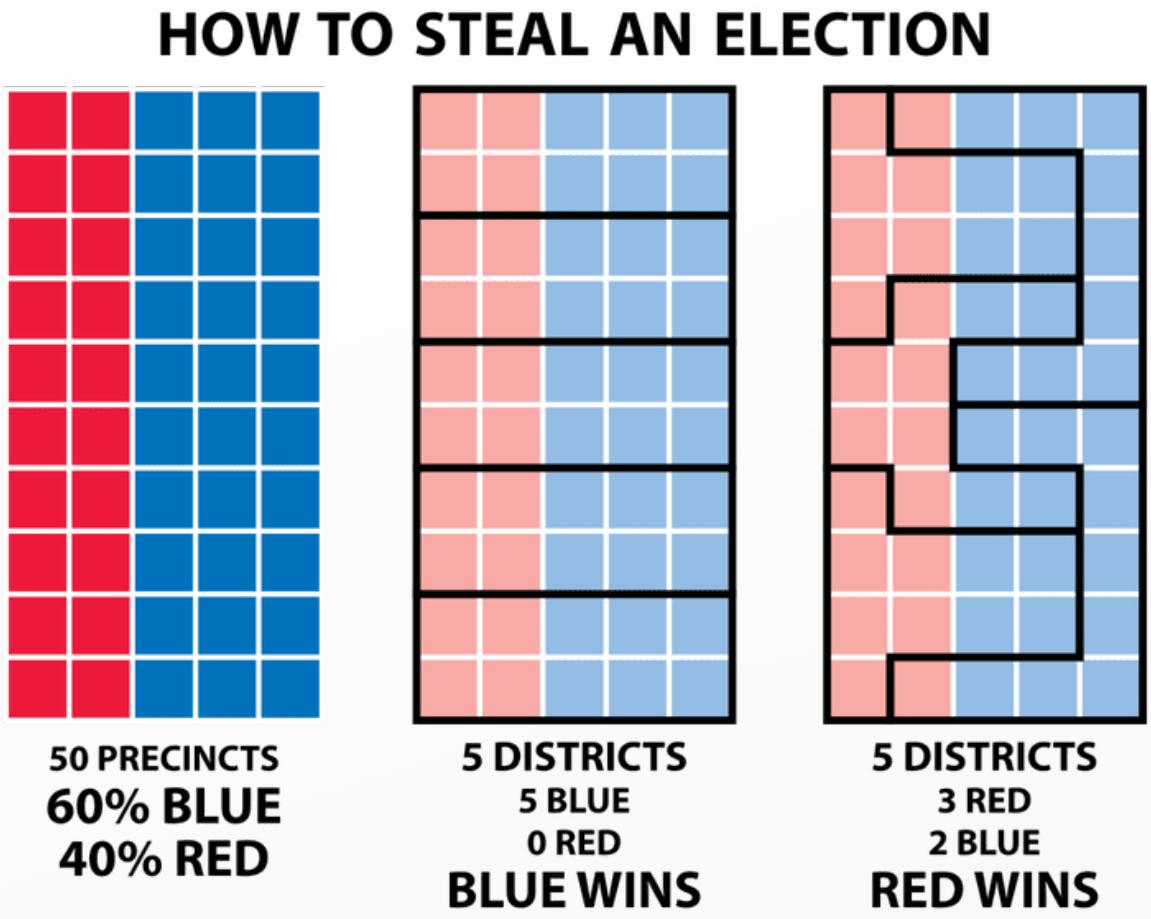
Fake news is not the only threat with social media however, as siloed opinions can also induce polarity, where cognitive dissonance and confirmation bias are reinforced by people being exposed only to groups of people that provide them the same perspective. Although contentious, these same neural networks could be utilized to ensure that people get exposure to a diversity of political perspectives, in order for people to form more educated opinions and decisions with regards to political choices.

Finally, another important arena where artificial intelligence can be instrumental is with defeating partisan gerrymandering. Gerrymandering is a practice intended to establish a political advantage for a particular party or group by manipulating district boundaries. In many jurisdictions, incumbent political parties get the opportunity to define district boundaries, which furthermore defines the districts that vote for respective representatives in legislative bodies. Unfortunately, this creates a conflict of interest, wherein districts should ideally be created in a way that is most consistent with overall political split, but parties are incentivized to manipulate district lines to draw favorable results.

Gerrymandering is difficult to prove, difficult to avoid, and difficult to defeat. Any purported "independent" actor drawing lines is still susceptible to human bias, and it seems impossible to draw lines that can please everyone. The only way to have a truly independent third party to draw the lines, is if the third person in question weren't a person at all, but instead an algorithm.

A group of Illinois researchers aren't the first to propose using artificial intelligence as a solution to the redistricting process, however they hope their new approach will be more accessible and fair than previous attempts at stopping gerrymandering with computation. These computer scientists are motivated by the belief that data and algorithms will create transparency in the notoriously opaque redistricting process by exposing the inputs and parameters that led to redrawing a district a certain way. With these inputs and parameters exposed, data scientists hope this will hopefully incentivize a more equitable redistricting process. With algorithms drawing truly random districts, citizens can be certain that their districts were drawn in meaningful yet equitable ways.

The Future of Voting



Every piece of technology mentioned in this paper can be used for good or for bad. Algorithms can facilitate gerrymandering, AI can help the spread of fake news, biometric information and mobile technologies can aid social surveillance, and blockchain nodes are still susceptible to the people who set them. Elections are central to our lives, and results are discussed often. It is my opinion that while the end results are discussed often, the causes are discussed too little. The mechanics behind an election matter, and hopefully the emergence of these technologies will foster a dialogue about the way that elections take place.

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