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# Gov2020: A Journey into the Future of Government

By William D. Eggers and Paul Macmillan

Global Public Sector | Thinking people





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# Introduction

Welcome to Government 2020. The purpose of this project is to help leaders from all sectors make sense of the rapidly changing demographic, societal, economic, and technological trends shaping our future. Gov2020 isn't a crystal ball but it does pull together some of our best Deloitte research and expertise from across the globe to start a discussion on what is probable, and even more importantly, what is possible for those who are most willing to embrace change.

Gov2020 is meant to be a starting point for governments wishing to engage with the future. It provides policy makers with some provocative ideas about what is possible and a catalyst to evaluate whether they are ready to embrace a future that should be very different from today. Effectively responding to the drivers of change and shifting needs of citizens will challenge virtually every process, system and structure of government.

Gov2020 is the culmination of an extensive exploration of the drivers that are influencing the future of education, human services, defense, transportation and more and the impact those forces of change might have on government and society at large.

Gov2020 brings together in one easily navigable place a rich source of analysis, video and creative visualizations about the future of government. On the website you can explore:

- **39 drivers** that will influence the way government operates and serves its citizens
- **194 trends** that represent the shifts that are likely or at least possible by 2020
- **15 videos** depicting major new developments, from the future of government work to the impact of 3D printing
- **15 infographics** illustrating new capabilities like digital age transportation and a sensor-enabled world

This project draws from hundreds of interviews conducted by dozens of colleagues over a multi-year period with leading experts from around the world. Much of the research resulted in in-depth Deloitte studies covering everything from the transition to digital age transportation to what a system of virtual incarceration might look like.

The confluence of several factors—demographic, socio-economic, and technological—will influence what happens in the future and ultimately, how governments evolve to meet citizens' changing needs. Understanding these factors or 'drivers of change' and their potential impact is the first step in preparing for the future.

## The Drivers of Change

**Demographic Drivers:** Demographic changes will have a significant impact in 2020. The aging population will dominate many policy and workforce discussions in the West, while population growth will continue to slow across most developing nations. The world is in the midst of a massive, long-term shift in wealth, economic power and population growth from West to East. As Asian areas outgrow their western counterparts, new political, social and consumer constituencies start flexing their power on the world stage.

Globally, the improved socio-economic status of women will bring billions more people into the formal workforce in the future. Megacities burgeon across the globe, while increased global migration leads to mingling cultural identities and the rise of the truly global citizen.

**Societal Drivers:** Society grapples with the undesirable effects—security and privacy concerns—of a hyper-connected, digital lifestyle. Governments are faced with a balancing act: using the latest technologies to meet the rising expectations of hyper-connected citizens, while still reaching those offline. Citizen-consumers, empowered by information and technology, play a bigger role in societal problem solving as well

as in fighting corruption. Unprecedented advances in health care, neuroscience, technology computing, nanotechnology and learning begin to allow human beings to expand their physical and mental faculties. However, potential innovations that enhance cognitive capacity also pose new regulatory and ethical challenges for business, government, social institutions and international organizations.

**Economic Drivers:** Building off the early bitcoin example, currencies will take on new digital and data-based forms in the near future. Social consciousness surfaces as a common theme, with more organizations and citizens contributing to societal change and driving a renewed sense of openness, innovation and empowerment. Governments grapple with fiscal stress, infrastructure bottlenecks and rising income inequality among citizens. But even while disparities between rich and poor persist, scarcity of basic requirements such as food, water, energy, healthcare, housing and education will begin to get addressed as technology raises the basic standards of living for many.

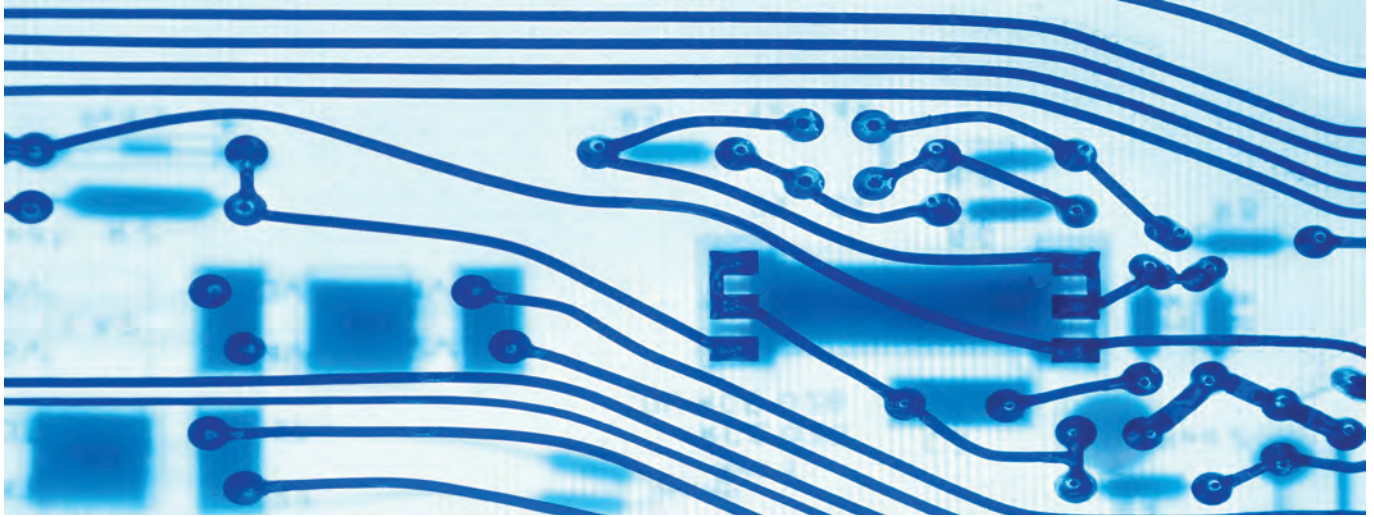
Climate change remains a major concern in 2020 and differing national policies concerning the sale and ownership of natural resources become a top priority area for international organizations such as the UN and World Economic Forum.

**Digital Technologies:** The digital revolution hinges on the convergence of four prominent technologies—social, mobile, analytics, and cloud—collectively called SMAC. In 2020, social networks penetrate all realms of life as individuals and governments explore new ways to tap into the power of the crowd using advanced analytics and sentiment analysis. Mobile devices of all shapes and sizes, including wearables like watches and glasses, keep millions around the world constantly connected, entertained and informed. Mobile tools revolutionize health care and education while mobile payments via Near Field Communications (NFC) become the norm.

Cloud computing accelerates the capabilities of technologies like mobile and analytics. Remote computing services allow mass collaboration around huge data sets, bringing affordable scale to computationally intensive problem-solving. Advanced algorithm design and faster computing, along with a growing cadre of data scientists, unlock value from digital exhaust, influencing decision making by governments, corporations and individuals alike.

Data is viewed as a tradable asset: by 2020, most consumers collect, track, barter or sell their personal data for savings, convenience and customization, making information a currency in the truest sense.





**Exponential Technologies:** “Exponential technologies” have a far-reaching, transformative impact across geographies and industries. These technologies represent unprecedented opportunities and existential threats; but their wide-ranging impact is indisputable. Developments in “additive” manufacturing, or 3D-printing, spur a second industrial revolution. Falling prices of 3D printers, coupled with growing expertise and new applications, increase the demand for and availability of this technology.

2020 sees robotics gain momentum and become vital components in a number of applications. From swarms of “microbots” to self-assembling modular robots to strength-enhancing robotic exoskeletons, applications using robotics cut across industries and transform the way work is done. Robots paired with Artificial Intelligence perform complex actions and are capable of learning from humans, driving the intelligent automation phenomenon. The centuries’ long quest to develop machines and software with human-like intelligence moves closer to reality. Scientists develop intelligent machines that can simulate reasoning, develop knowledge, and allow computers to set and achieve goals, moving closer to mimicking the human thought process.

**Cyber-physical systems technologies:** Previously, computers were embedded in stand-alone and self-contained products. With the advent of the web, these embedded computers became networked and are evolving into cyber-physical systems (CPS) that sense, monitor, and control the human and physical environment. This feedback loop of sorts in which embedded computers and networks control the physical processes, and physical processes in turn affect computations hold tremendous economic and societal potential. These “smart” systems permeate into the infrastructure around us.

In 2020, unmanned aerial vehicles or drones contribute to domestic policing, geographical surveys, maritime patrol and delivery of goods, among multiple other commercial and military applications. The future also promises radical improvements in augmented reality technology with the introduction of gestural interfaces and sensory feedback that fuses the physical world with digital information. As the size and cost of sensors and communication technologies continue to decline, the “Internet of Things” (IoT) grows by leaps and bounds.

Businesses and governments struggle to integrate this evolving technology, using analytics to winnow insights from the treasure trove of data that improve delivery models in health care, transportation, security and defense, infrastructure management and many other areas. The exponential growth of the IoT could prove to be a regulatory headache, forcing governments to keep pace with the ever-changing technology.

These drivers will influence government differently. However, these seven mega shifts are more likely to be seen across government and have transformational effects.

### The Seven Mega Shifts

Across the world, trust in government is at an all-time low, citizen expectations are rising, and government finances are under stress. The result: the gap between citizen expectations and government’s ability to meet them has never been greater. Our current industrial age model of government needs to change radically to close this gap.

But how? What are the main features of a government better suited for our times? How will the forces identified earlier significantly change government, and which of them have the greatest potential to make a positive difference and which represent the biggest threats?

These seven major trends have the potential to reshape government-in many cases from the outside-and transform the public sector.

#### Shift #1: Government as an enabler instead of a solution provider

In 2020, the most successful governments focus on developing societal solutions from outside government, rather than on trying to solve problems themselves. They build platforms, hold partners accountable for targeted outcomes, open up services to choice, and manage crowdsourced campaigns and competitions. One result: a big increase in public-private partnerships. This in turn encourages the growth of triple-bottom line businesses that pursue social and environmental goals along with financial ones.

#### Shift #2: Made-for-me service delivery

We are 20 years into a shift towards more personalized services, and government is not immune from the forces underlying this shift. Between now and 2020, scores of

public service interactions in Western governments will be personalized and available from home and mobile devices. For example, a Fish and Game stamp could have a scannable barcode that ensures authenticity, so an angler can print it at home, eliminating an in-person visit.

Many government services continue to go mobile, moving out to neighborhoods (perhaps on “taco truck” style vehicles) and deliver in-person services to constituents. Why? Because large centralized offices don’t make sense when different groups of people have different needs, or when many traditional functions can be handled remotely through digital services.

### **Shift #3: Distributed governance**

Increasingly, “government” functions are being “co-created” with citizens, on their own or working with others. Technology makes it possible to distribute tasks to citizens. For example, Hawaii’s tsunami siren app coordinates citizen volunteers who adopt a warning siren and take responsibility to ensure it has functioning batteries.

Carefully designed co-creation processes will allow policy designers to work side-by-side with citizens to build better prototypes and test them more realistically, increasing the final policy’s effectiveness.

Crowdsourcing initiatives will allow individuals to share their experiences across many levels of the legislative process. Wikipedia-like sites could highlight problems-and solutions-about which citizens care most deeply. Open data provide citizens access to the information that once required a staff of legislative experts to collect and analyze.

### **Shift #4: Data-smart government**

Predictive modeling and other types of data analysis allow the public sector to focus more on prevention, instead of just reaction and remediation. For example, rather than simply reacting to custodial parents calling to report they are not receiving child support, a predictive model can alert enforcement officers ahead of time about the non-custodial parents most likely to go into arrears.

Psychological approaches, like the UK’s Nudge Unit, can help communities move in healthy directions. For example, electric or water bills that graphically show usage stats can significantly reduce household waste. (Some power companies now show households how their usage compares to their neighbors.) Of course, nudging citizens is a delicate task, and governments will have much to learn about the right-and wrong-ways to do this.

Analytics give policymakers the ability to test potential solutions in advance. These tests won’t be perfect, but they represent a more fine-tuned approach to predict, say, whether a policy that worked for one segment of society will work for another.

### **Shift #5: Alternative forms of government funding**

Technology opens up many unique alternatives to fund services and infrastructure, which is good news in our era of fiscal restraints. We already see increased use of payment-for-results models-such as social impact bonds and tax increment financing (TIF)-to finance costly development projects and services. In essence, these initiatives flip the old models and move some financial risks from governments to investors and contractors.

Dynamic pricing and pay-as-you-go systems will replace the blunt pricing models of the past. With greater frequency, governments will allow citizens to pay in real time for the services they use. To ensure the right balance between supply and demand for infrastructure services, governments will employ multiple forms of dynamic pricing for road use and parking. In simple terms, social costs and benefits, get better reflected in the price.

### **Shift #6: Just-in-time civil service**

Radical changes in the public sector’s talent model are possible. One option: governments apply the consulting staffing model to their workforces. Employees won’t stick to departments, but instead will move from project to project. Advanced HR policies will track skills, accomplishments, and certifications in ways that keep employees engaged.

Governments will also expand their talent networks to

include “partnership talent”(employees who are part of joint ventures), “borrowed talent” (employees of contractors), “freelance talent” (independent, individual contractors) and “open-source talent” (people who don’t work for government at all, but are part of a value chain of services). This shift from a closed model to an open, more inclusive one will redefine what “public workforce” actually means.

#### **Shift #7: A new basis for national prosperity**

Critics have long criticized both GDP and GNP metrics for failing to measure social success. Bobby Kennedy famously said, “Gross National Product counts air pollution and cigarette advertising... yet the Gross National Product does not allow for the health of our children, the quality of their education or the joy of their play.”

Society has evolving attitudes about what defines success, and new methods will measure social good. They will include more holistic measures of progress and well-being such as personal safety, ecosystem sustainability, health and wellness, shelter, sanitation, inclusion and personal freedom. Taken together, they will change how societies assess their progress; placing new demands of government and business.

#### **Sector Trends**

Changes or shifts in the way government operates as a whole will have implications for the various sectors within government. For example, what could data-smart government mean for law and justice? Or how could alternative forms of funding improve transportation? The following sector trends reveal how high-level changes could trickle down to individual segments of the public sector.



**Education:** Step into the classroom in 2020 and see powerful forces at play. A global shortage of skilled talent propels career-focused learning. Virtual learning, digitization, and augmented reality have made our old definitions of a classroom obsolete. Evolving learning needs redefine what education means, who delivers it and how. Students become teachers, learning from one another through project-based learning and self-organized learning environments. Education funding shifts to pedagogical approaches proven to work via real-world trials. Unbundled, personalized, and dynamic education is the new normal.

**Energy and Environment:** Conversations on energy and the environment center on the three Cs—connect, collaborate, and coexist. Smarter devices result in smarter energy choices, while networks of sensors, drones, citizen regulators, and conscious consumers work together to monitor and protect the environment. Rapid urbanization fuels innovation and the quest for sustainable and resilient cities. Entire markets emerge around sustainable solutions such as reducing food waste. Government regulation is less blunt—and heavily influenced by sensor-produced data.

**Health care:** The dominant health care trend in 2020 is, quite simply, pervasiveness. Mobile health apps, telemedicine, remote monitoring, and ingestible sensors generate rich data streams, allowing doctors and patients themselves to track every heartbeat, sneeze, or symptom in real time. Bioinformatics and analytics allow for personalized risk assessments and tailor-made medicine. Breakthroughs in robotics, 3D printing, and stem-cell research make surgical procedures safer and improve outcomes. Health care systems shift their focus to wellness and prevention to compete against insurgent competitors.

**Human Services:** Human services in 2020 are customized, data-driven, and technology-infused, continually redefined by new possibilities. Governments tap community assets and peer-to-peer support programs to augment service delivery. Behavioral psychology and economics play a larger role in designing interventions, while outcome-oriented social innovation financing helps scale the programs that work. Mobile technology, sensors, and wearable devices





enable remote monitoring while virtual check-ins complement in-person interactions. A new breed of caseworker-intrapreneur brings fresh ideas and innovation to human services organizations. Outcome-based funding moves beyond fringe status thanks to advances in measurement, data analytics, and inflows of private and nonprofit funding.

**Law and Justice:** 2020 sees law enforcement using innovative new methods and technologies to protect public safety and rehabilitate offenders. Mobile computing and electronic monitoring enable virtual incarceration. Gamified web and mobile interfaces deliver jobs training, community connections, and rehabilitation services. Data analytics ensure that interventions are tailored to offenders' profiles. As crime becomes more sophisticated, so does policing: drones act as eyes in the sky, while officers on the ground use wearable computing, facial recognition software, and predictive video. The fight against cyber- and biocrime shifts from a purely national responsibility to an increasingly important focus on local law enforcement.

**Transportation:** In 2020, transportation is as much about bits and bytes as the physical infrastructure on which we walk, bike, drive, and ride. Sensor-powered dynamic pricing, mobile-enabled collaborative transport models such as ridesharing and social transport apps, all help tackle traffic congestion in major urban corridors. Tremendous advances in connected and automated vehicle technology put the first fleets of autonomous or semi-autonomous vehicles on the roadways. Sustainable

transport options such as electric vehicles and e-bikes become widespread. Air travel is reimagined through augmented reality-enabled self-service airports, while the skyways see greater drone use for civilian and commercial purposes.

**Defense:** Security and warfare look very different in 2020. Electronic intelligence and surveillance functions driven by big data have become key defense requirements. Wearable sensors, smart uniforms, and performance-enhancing supplements significantly boost the capabilities of the next-generation soldier. Robot and drone armies strike with precision but sometimes blur the lines drawn by conventional laws governing warfare. An upsurge in cyber-warfare makes it increasingly difficult to distinguish between the actions of terrorists, organized criminals, fringe movements, nation states, and teenage hackers. Procurement sees a departure from historic norms with the rise of 3D printed weapons and challenge-based R&D models.

## Conclusion

In 2020, the most agile governments openly embrace the new possibilities of technology and civic engagement as they reposition to affect better outcomes. Outside drivers will eventually force change within governments, but many will take steps today to proactively reshape their futures in ways that produce measureable benefits for society. We expect increasing numbers of partnerships organized around innovative solutions that ignore old pathways and divisions between non-profit, corporate, and government. Expect to see simplified interactions with citizens, more dynamic workforces, more accurate assessments of each program's impact, and greater citizen participation in civic work and civic policy.

Don't expect government to hold still. The immediate future is bringing many inevitable changes; the opportunities to enable progress are too compelling.



**William D. Eggers** leads Deloitte's public sector research and is the author of eight books, including his newest, **The Solution Revolution: How Business, Government, and Social Enterprises are Teaming up to Solve Society's Toughest Problems** (Harvard Business Press

2013). You can connect with him at [@wdeggers](https://twitter.com/wdeggers) or by email at [weggers@deloitte.com](mailto:weggers@deloitte.com).



**Paul Macmillan** is the global public sector leader for Deloitte Touche Tomatsu Limited, where he is responsible for the network's client service innovation to support public-purpose organizations around the world. He is the co-author of *The Solution Revolution*. You can connect

with him at [@Paul\\_Macmillan](https://twitter.com/Paul_Macmillan) or by email at [pmacmillan@deloitte.ca](mailto:pmacmillan@deloitte.ca).

# Drivers

## Demographic Drivers

Demographic factors like aging, rapid urbanization and the rise of a truly global citizen create ripples of change in 2020.

### Going grey: the aging population and demographic divide

Declining fertility rates coupled with remarkable improvements in healthcare and longevity drive the aging of the world's population. It doesn't affect nations uniformly, however some are facing a "demographic divide" between their young and aging populations much earlier than others. The decline of the working-age population and growth of the elderly, dependent segment has far-reaching implications on workforce dynamics, government services, healthcare costs and economic growth. Greater female participation in the workplace, however, helps to mitigate the economic impacts of global aging. Nations with predominantly young populations—such as India, where one third of the population is under the age of 15—see a significant boost in their economies and labor markets.

### Megacities

Rapid urbanization and expanding city limits lead to the continued emergence of "megacities," major urban agglomerations that become largely autonomous hubs for customers, talent, investment, wealth creation and growth. Despite their importance, however, there are still significant limits to their ability to address universal problems such as climate change or to pursue other national or global goals. But even this may change: as mayors around the world tackle difficult societal problems, what succeeds in one megacity can quickly become a global standard. Given their scale, this kind of domino effect can affect massive numbers of people.

### The age of empowered women

In 2020, women have made significant improvements in their social and economic positions, largely due to better access to education and employment. Shifting dynamics in women's attitudes towards family life and childbearing (with more choosing to postpone marriage and children) cause a change in the conventional

trajectory for life events and career decisions. Growth areas in industry and employment become the primary driver in career choices, rather than traditional conceptions of "gender skills."

Markets with aging populations see men moving into traditionally female-dominated caring professions, while countries with growing technology and engineering industries like China and India see a faster elimination of the gender imbalance in the STEM sectors.

As a consequence of declining birth rates and increased opportunities for women, maternal health globally improves considerably. We see fewer orphans, declining malnutrition, greater academic enrollment and performance and other positive contributions to social stability.

### Slum growth continues unabated

In 2020, more than 1.4 billion people live in slums—more than one in seven people worldwide. The megacities of the developing world are home to many of its most rapidly growing slums and much of its urban poverty. Since developing nations' slums grow faster than their cities, they are overcrowded, polluted and dangerous, and often lack basic services such as clean water and sanitation. Slums have been called self-reinforcing "poverty traps." Curtailing their growth and providing them with infrastructure and basic amenities become critical.

The global share of women in national parliaments rose from 15.1 percent in 2003 to 21.4 percent in 2013.

### Rise of the global citizen

Globalization, improved education and a shortage of local talent drive migration across the globe. Knowledge workers, aided by relaxed immigration policies and international competition for skilled talent, are no longer bound by national identity or citizenship. Growth in Asian economies such as India and China causes a decline in emigration from these nations, reversing previous trends. As these “global citizens” continue to spread, we see a different kind of migration, driven by refugees escaping natural disasters and resource scarcity in their home countries.

### East outgrows West

The world is in the midst of a massive, long-term shift in wealth, economic power and population growth from West to East. As Asian areas outgrow their western counterparts, new political, social and consumer constituencies start flexing their power on the world stage. In 2020, Asia is home to nearly two-thirds of the world’s middle-class consumers, and 40 percent of their spending. Fueling their growth is the rise of Asian industry, which increasingly challenges—and in many cases, supplants—the technological advantages the West has long enjoyed.



## Economic Drivers

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### From digital currencies to growing emerging markets, these represent a host of economic factors shaping 2020.

#### Rising income inequality

Driven by factors including the aging population, rising unemployment and skill gaps in developing countries, global income inequality rises. While household wealth grows significantly in aggregate, reaching \$334 trillion by 2020, it does not result in a corresponding decline in inequality. Even so, the world's poor have much greater access than before to goods and services previously available only to the rich and middle class.

More than two-thirds of the world's adults in 2014 have wealth of less than \$10,000, while the wealthiest 0.7 percent holds 41 percent of the world's wealth.

#### Innovating to zero

"Innovating to zero"—fail-proof systems that reduce unnecessary or unwanted outcomes to zero—becomes a common business goal manifested in many ways, such as "zero security breaches," manufacturing with "zero defects," cars and transport systems that produce "zero accidents" and "zero casualties" in traditionally dangerous industries like mining.

#### From scarcity to abundance

While disparities between rich and poor persist, scarcity of basic requirements such as food, water, energy, healthcare, housing and education is no longer the worldwide norm. As Peter Diamandis, founder of the X Prize Foundation and Singularity University, says, "Humanity is now entering a period of radical transformation in which technology has the potential to significantly raise the basic standards of living for every man, woman and child on the planet."

#### Talent and the skills gap

The ability to foster, develop and maintain generations of educated, skilled employees becomes a priority for countries around the world. Many nations grapple with aging workforces and a lack of skilled technical talent. These forces drive the "freelance economy," in which labor moves between jobs fluidly, prompting changes in immigration policies and influencing education and training. Governments, private companies and educational organizations come together to address the growing skills gap and embed paradigm shifts such as "lifelong learning" in the workforce. The global contest for talent defines which nations lead the world economy for years to come.

#### Digital currency mainstreamed

2020 sees alternatives to cash and traditional currency systems gain momentum. Decentralized cryptocurrencies—the successors of Bitcoin, Ripple, Peercoin, Namecoin, Litecoin and others—gain a toehold in a digital, largely cashless economy. Mobile payments are a natural extension of the digital lifestyle, while protection against digital theft becomes an imperative for regulatory agencies around the world.

### Data as currency and asset

In a hyper-connected, sensor-driven world, virtually everything and everyone generate a vast amount of data, all the time. Much of that new information will consist of personal details: where people have been, what products they've bought, what movies they like, which candidates they support—the list is nearly endless. By 2020, more than 80 percent of consumers collect, track, barter or sell their personal data for savings, convenience and customization, making information a currency in the truest sense. The production and use of troves of data encourages “citizen innovators” to transform open data into solutions and applications.

By 2020, the amount of digital data exceeds 40 zettabytes, the equivalent of 5,200 gigabytes of data for every man, woman, and child on earth.

### The circular economy

For more than two centuries, humanity's use of natural resources basically stayed the same: take, make and throw away. By 2020, however, businesses adopt a new approach, viewing the resources as assets instead of inputs, and their customers as users rather than buyers. In this model, companies realize it makes little business sense to discard assets after only one product cycle, and instead strive to continually re-acquire and reintroduce these assets to market. CEOs and product designers attempt to maximize the value of their products by focusing on questions such as “How can we design our products with asset recovery in mind?” and “How can we obtain source material in regenerative loops instead of linear flows?”

### Radical openness becomes the norm

The trend towards radical transparency has been mounting for some time, with companies increasingly opening their data (GlaxoSmithKline), supply chain (Apple) and culture (Zappos) to the public. In 2020, these models are no longer confined to a handful of innovative organizations. Instead, they dominate most industries, as consumers demand information that was traditionally kept private before they will engage with the organization. This is particularly true in the food space, where sustainability reputations and labeling become a prerequisite to doing business.

### A “barbell” economy

As global giants increasingly acquire mid-sized companies, a “barbell” economy emerges, in which wealth is concentrated in a handful of huge, borderless corporations at one end, and a large group of small and “micro” companies at the other. Small companies find spaces untouched by the giants where they can grow and flourish. These areas often become the most important sources of innovation.

### The next billion consumers

As emerging market economies flourish, huge new markets open up to global brands. These “next billion” consumers, however, are vastly different from those that preceded them. While many earn more than \$5,000 a year, making them part of the global middle class, they are still significantly poorer than their western counterparts. As a result, companies that want to do business in these markets must completely rethink their product mix and finances to compete at a much lower price point.

### Twin forces collide: water scarcity and climate change

Urbanization, rising standards of living and associated consumerism puts increasing pressure on already scarce resources. The perception of scarcity may trigger conflicts and unrest before actual shortages are even felt. Climate change exacerbates these effects. Scientists increasingly agree that climate change will restrict our access to vital resources including food, water, land and energy. According to the UN Food and Agricultural Organization, by 2025 1.8 billion people will live in regions with absolute water scarcity, and two-thirds of the world population could face water stress.

Water scarcity drives continuing transformation in industrial production and technologies. Nestlé has committed to cut its water use in Europe by 40 percent by 2020. Differing national policies concerning the sale and ownership of natural resources become a top priority area for international organizations such as the UN and World Economic Forum.

### Infrastructure bottlenecks

Infrastructure is a basic pillar of economic competitiveness. By some estimates, western nations will need to commit trillions of dollars in the next decade simply to modernize aging infrastructure. Developing countries must build new infrastructure to support economic growth and bring vast majorities of people out of poverty. But the difficult economic and fiscal environment limits infrastructure spending in critical areas including land transportation, water networks and energy grids.

By 2020, the world needs a 13 percent increase in food production to meet the demand of 7.8 billion people, an addition of 890 million tons.



## Societal Drivers

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### Society adapts to the positive and negative effects of a hyper connected, digital lifestyle.

#### Living with technology's dark side

Some negative effects of rapid technological assimilation will intensify. Indiscriminate sharing, surveillance and hyper-connectedness prevail at the expense of privacy. In an age marked by open data and transparency, some technology users rebel, seeking new ways to restore anonymity. Cybercrime tracks technology's advance, leaving everything that's connected—from basic household gadgets to unmanned vehicles—vulnerable. The clash between sharing and surveillance reaches new heights as the Internet of Things brings more and more of our lives online. Average citizens face a choice between using connected technologies and maintaining their anonymity. Privacy itself becomes a currency for which users are willing to pay or go to great lengths. Meanwhile, regulation of technologies such as 3-D printing, which anyone can use to print weapons, presents a growing challenge to government authority.

Economic losses from cyber-attacks rise to \$3 trillion by 2020.

#### Empowered citizen-consumers

Since the advent of the Internet futurists have repeatedly promised a new kind of citizen—one who is proactive, connected, collaborative and aspiring to contribute to a better society. By 2020, these citizens are finally beginning to appear in significant numbers. Businesses, nonprofits and governments spur the movement with the right data and tools. Some of the earliest examples are already visible in the sustainability space, where energy agencies spearhead efforts to simplify electricity bills and visualize data from the smart grid. In doing so, they help consumers make better decisions for themselves, while—perhaps unknowingly—contributing towards policy goals that benefit the public good.

#### The “hyper-connected” vs. the barely connected

In 2020, most people are networked across numerous platforms, digital and physical. But a significant share of the population—predominately the poor, the elderly and those living in areas with limited connectivity—remains barely connected. This poses continuing challenges for the delivery of public services: governments must use the latest technologies to meet the rising expectations of hyper-connected citizens, while still reaching those offline.





### Expanding human potential

Unprecedented advances in health care, neuroscience, technology, computing, nanotechnology and learning begin to allow human beings to expand their physical and mental faculties, with the range of possibilities including enhanced longevity, improved IQ and learning abilities and the restoration of hearing and vision. Early signs of this included President Obama's \$100 million BRAIN initiative to advance the study of the nature of the brain, particularly how brain function is linked with behavior, learning and mental disease. But potential innovations in cognitive capacity also pose new regulatory and ethical challenges for government, social institutions and international organizations.

In the United Kingdom, life expectancy is increasing at the rate of six weeks every year; 11 million people alive today—17.6 per cent of the UK population—can expect to live to be more than 100.

### The conscious consumer

The trend toward more mindful consumption becomes a dominant force in the West and makes inroads in emerging markets, as increasing number of consumers demanding responsibly sourced and environmentally friendly products. Consumers and corporations work towards transparency, openness and social responsibility. Consumers use apps to align their purchases to the companies that support their values and social causes.

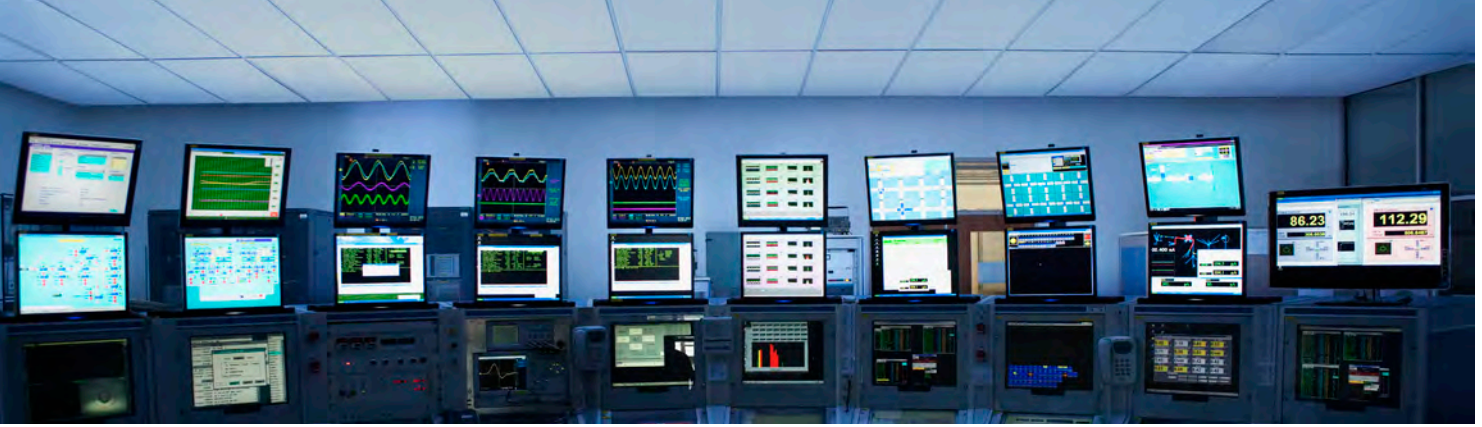
### Chipping away at pervasive corruption

Digitization of services and open-government initiatives make a dent in corruption, but it continues to persist in most of the world. Rampant corruption in emerging economies prevents the benefits of development programs from reaching the poor. Early innovations in harnessing the power of citizens to track corruption at the lowest levels of government, such as India's "I Paid a Bribe" platform or Global Youth Against Corruption (GYAC), give way to more systemic approaches. Conveners such as Transparency International bring together anti-corruption activists and technology experts in hackathons to build tools to fight corruption on the ground. Anti-corruption efforts go beyond tracking to provide training and advocacy tools that allow citizens to connect on corruption issues and take legal action against perpetrators.

### Resolving the privacy debate

In 2020, the clash between privacy and convenience hasn't been fully resolved, but significant headway has been made. Individuals increasingly accept the idea that technology can serve them better when it knows about their lives, and rules and norms governing this information exchange have finally begun to crystallize. The remaining battle lines are drawn around innovations that digitize entirely new aspects of life. Advances such as self-driving cars and smart homes force us to consider how much our possessions know about us, what they actually "report back" and to whom. At its core, this is a debate about individual independence. As with past trends, most people are willing to sacrifice some privacy for convenience.

Initiatives such as Nigeria's still-evolving Anti-Corruption Internet Database (ACID) could be one among the first steps toward an end-to-end solution for corruption.



## Cyber-Physical Systems

In 2020, computers evolve into connected systems that sense, monitor, and control human and physical environments.

### Geospatial technology 2020

Location becomes an integral dimension of data, allowing information patterns and decisions to be viewed through the lens of place. Since entities on earth can be tagged by location, Geographic Information Systems (GIS) finds varied applications ranging from movement of weather patterns to traffic management in crowded cities to location-based services to forming the backbone for the Internet of Things. The use of GIS in the field of medicine and infrastructure planning grows as governments open up their GIS databases for public use.

### Geospatial technology in 2020

- **Geomedicine** aids clinical diagnosis by providing a more precise understanding of the links between patient health and contextual factors, such as where they live, work, and play.
- **Indoor GIS** enables navigation in large covered areas such as stations and airports by relying on indoor systems such as Wi-Fi re-transmitters used to receive GPS satellite signals.
- **Passive GIS** syncs vast amount of spatial-related information from social networks with satellite generated location to enhance the location and user activity information.
- **Multi-source geofencing** provides spoof-proof user location and authentication by relying on multiple methods for verifying a user's location and identity.
- **'Internet of Things' with a geo layer** provides a vital link between the sensors that would generate the Uniform Resource Identifier (URI) assigned to a thing or an object.
- **GIS enabled intelligent infrastructure** helps create safer and more energy efficient infrastructure, especially in transportation and energy sector.

- **Open government geospatial data** including LiDAR (Light Detection and Ranging) and high-resolution aerial imagery is made available and consumable via APIs to power multiple applications.

### Sensors 2020

Networks of sensors measure and record everything from temperature, light, and motion to biohazards and physical indicators from the body. Sensor-enabled devices communicate with each other through the "internet of things," ingestible sensors monitor the body from the inside, and intelligent swarms of sensors co-ordinate with each other to collect data. Declining costs and advancements in sensor technology make it accessible, widely used and an integral part of the 2020's digital ecosystem.

### Sensor technology in 2020

- **The 'unobservable' sensing** breaks new ground in sensing biohazards, smells, material stresses, pathogens, level of corrosion, and chemicals in material.
- **Micro-sensor implants** in patients track the healing process for internal injuries, enable health care professionals to take remedial action based on continual data from the system.
- **Biodegradable sensors** monitor soil moisture and nutrient content for optimum crop production.
- **Self-powered sensors** that are powered using the heat difference between the patient's body and surrounding air find applications in medical care.
- **Self-healing sensors** repair themselves in the event of disaster or other structural disruptions.
- **Live cell-based sensing**, an amalgamation of sensor technology and living cells, allow scientist to understand the biological effect of medicines, environment, and biohazards.

- **Sensor swarms** coordinate their activities, deciding what to measure and where through a self-learning system directing their movements and data collection.
- **Smart dust**, microscopic sensors powered by vibrations, monitor situations ranging from battlefield activities, structural strength of buildings, and clogged arteries.

### The “Internet of Things”

As the size and cost of sensors and communication technologies continue to decline, the “Internet of Things” (IoT) grows by leaps and bounds. In 2020, more than 30 billion devices are connected to the Internet. Businesses and governments struggle to integrate this evolving technology, using analytics to winnow insights from the treasure trove of data that improve delivery models in health care, transportation, security and defense, infrastructure management and many other areas. The exponential growth of the IoT proves to be a regulatory headache, forcing governments to keep pace with the ever-changing technology.

#### The Internet of Things in 2020

- **Privacy takes center stage** as multitude of “things” become sources of data; new pay-for-privacy model emerges that protects data and allow consumers control over their data.
- **Intervention applications** materialize as the advent of smart sensors and advanced analytics enable IoT applications to move beyond just monitoring.
- **Standardization of IoT** objects, sensors, systems, and processes begin as large players in the industrial internet marketplace converge to evolve industry standards.

In 2020, up to 30 billion devices with unique IP addresses are connected to the Internet.

### Augmented reality 2020

Augmented reality (AR) allows users to experience their physical, real-world environment so that its elements are augmented by computer-generated sensory inputs such as sound, video, graphics, or GPS data. As information becomes more and more pervasive, overlaying information on reality becomes the norm for enhanced decision making. The future promises radical improvements in AR technology with the introduction of gestural interfaces and sensory feedback that fuses the physical world with digital information.

#### Augmented reality in 2020

- **Screen-less future** becomes a reality as wearables become ubiquitous; any flat surface doubles up as a screen.
- **3-D visualization** and mapping capabilities in conjunction with AR technology help navigate places with updated situational awareness.
- **Visualization of data** becomes seamless as users can access centralized data on the go through wearable technologies; it finds application in law enforcement, emergency response, and human services.
- **Gestural interfaces**—ways for humans to use body language and actions to control technology—begin to redefine the human-technology relationship, ushering in a sort of omnipresent “sixth sense.”
- **Haptic (tactile) technologies** redefine training in key government mission areas including defense, law enforcement, and health care.

### Unmanned Aerial Vehicles (UAVs)

Remote controlled or autonomously flying aircraft inhabit the skies in 2020. These unmanned aerial vehicles or drones contribute to domestic policing, geographical surveys, maritime patrol, and delivery of goods, among multiple other commercial and military applications.

#### Unmanned Aerial Vehicles in 2020

- **Multifunctional drones** allow multiple features to be assembled on a single drone; for instance a single drone can be used in monitoring local traffic, local law and order, and the environment.
- **Self-learning drones** equipped with artificial intelligence, make autonomous navigation decisions allowing them to fly with minimal human intervention.
- **Micro UAVs** shrink drone sizes and work in swarms to provide surveillance in the battle field; the Air Force has experimented with ‘flybots’ that can hover, stalk, and kill targets.
- **Solar powered drones** mitigate the range issues and allows recharging of batteries from a network of solar-powered charging stations.
- **3D printed drones** help develop lightweight, rigid UAV structures that improve performance and cut costs.



## Digital Technologies

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Rapid advances in social, mobile, analytics, and cloud technologies take computing to the next level.

### Analytics 2020

With unprecedented amounts of new information being created and shared every second, analytics becomes a powerful force transforming data from gigabytes into golden insights. Advanced algorithm design and faster computing, along with a growing cadre of data scientists, unlock value from digital exhaust, influencing decision making by governments, corporations, and individuals alike.

#### Analytics in 2020

- **Crowd-aided analytics** that taps into the power of crowd in the analysis process, making the process efficient and less error prone.
- **Faster analytics through robust algorithms** mitigates the traditional trade-off between accuracy and speed.
- **Analytics for all end users** allows everyone in the organization to become an analyst, providing workable, data-driven insights.
- **Data scientist demand surges** as organizations examine complicated data sets to aid business decisions.
- **Cloud analytics** allows seamless interaction with big analytical and visualization systems in the cloud.
- **Advances in natural language processing (NLP)** enable users to analyze the vast array of data from social networks.

### Cloud computing 2020

Cloud computing takes center stage in 2020, accelerating the capabilities of technologies like mobile and analytics. Remote computing services allow mass collaboration around huge data sets, bringing aordable scale to computationally intensive problem-solving. Cloud computing closes the digital divide by making collaboration across distance and disciplines both possible and cheap. Governments use hybrid clouds to share information while protecting sensitive data and technology firms provide analytical capabilities through cloud platforms.

#### Cloud computing in 2020

- **Hybrid cloud computing** help governments house sensitive data in internal systems and the rest on the cloud; striking a balance between cost and data security.
- **Open clouds** based on open standards allow governments to share valuable data with citizens, ushering a new era of transparency.
- **Interclouds** enable government departments to cherry-pick cloud components from various companies; it acts as a one-stop cloud shop.
- **Modular software development** process in cloud application allow changes in applications to take place without taking the program offline.
- **Cloud-based analytics** revolutionizes an agency's analytics capabilities by reducing cost dramatically and enabling access to data across government agencies.

## Mobile technology 2020

2020 takes the ubiquity of mobile technology to the next level. Mobile devices of all shapes and sizes, including wearables like watches and glasses, keep millions around the world constantly connected, entertained, and informed. Mobile tools revolutionize health care and education while mobile payments via NFC become the norm.

### Mobile technology in 2020

- **Flexible mobile devices** break down physical barriers that traditionally defined and limited communication devices, tablets, and gaming controls.
- **Wearable technology** in the form of watches and glasses, powered with smart chips, allow users to browse the Internet, view pictures, navigate and experience augmented reality.
- **Mobile wallets**, leveraging the advancement in near-field communication (NFC), allow users to make payments directly.
- **5G networks** take user experience beyond data transfer speeds to include service quality factors such as lower battery consumption, larger number of supported devices and lower latency characteristics.
- **Mobile M2M technology** redefines health care, reduces carbon emissions, and help public services; by allowing users to transmit data on the go.
- **Real-time speech translations** on mobile devices eliminate language barriers, and improve one-to-many events such as webinars, training sessions, and conferences.

By 2020, mobile money spreads throughout Africa, allowing some of the 2 billion people without access to financial services to come into the formal system.

## Social Media 2020

In 2020, social networks penetrate all realms of life as individuals and governments explore new ways to tap into the power of the crowd. Location data used in conjunction with social networks create hyper-local social platforms. Niche or specific-interest based social networks allow people to customize and filter content, while privacy concerns drive the growth of temporary social media platforms. Social media provides a vital stream of data used by governments and corporations for advanced analytics and sentiment analysis.

### Social media in 2020

- **Social goes hyper local** with the interplay between social and geo location technologies, allowing consumers, businesses, and governments to connect and share on local issues.
- **Temporary social media** becomes mainstream where interactions are deleted after a specified time, thus enhancing user privacy.
- **Social network enable public safety** by offering platforms that track individuals 'marked' as possible convicts by national security agencies.
- **Niche social networks** emerge connecting users with specific interests, leading to market fragmentation.
- **Social TV** allow content creators and providers to deliver customized content based on social media activity of the users.

By 2020, over 5 billion people use social networks, about two-thirds of the world's population.

# Exponentials

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These fast-evolving technologies represent unprecedented opportunities as well as existential threats. Don't get caught unaware.

## Artificial intelligence 2020

The centuries' long quest to develop machines and software with human-like intelligence inches closer to reality. Scientists develop intelligent machines that can simulate reasoning, develop knowledge, and allow computers to set and achieve goals, moving closer to mimicking the human thought process. These intelligent systems improve accuracy of predictions, accelerate problem solving, and automate administrative tasks bringing in an era of automation.

### Artificial intelligence in 2020

- **Cognitive analytics**, where machines learn from experience and build associations, help develop technology systems that evolve hypothesis, draw conclusions, and codify instincts and experience.
- **Parallel information processing**, aided through chips custom designed for AI applications, help parallel processing of vast amounts of data.
- **Smarter gets redefined** with the advances in sensor, cloud, and machine learning technology, and pushes the boundary of smarter homes, cars, infrastructure, and just about everything.
- **Deep learning** approaches allow processing of raw data including images, speech, and natural language; thus providing deeper insights.
- **Face-reading machines** decipher micro facial expressions to build meaningful information on the emotional state of the user, improving human-computer interaction in areas of e-learning and e-therapy.
- **Intelligent automation** combines automation with artificial intelligence that allows knowledge workers, from physicians to investment analysts to plant supervisors, to process, understand and use ballooning volumes of information.

## Robotics technology 2020

2020 sees robotics gain momentum and become vital components in a number of applications. From swarms of "microbots" to self-assembling modular robots to strength-enhancing robotic exoskeletons, applications using robotics cut across industries and transform the way work is done. Robots paired with AI perform complex actions and are capable of learning from humans, driving the intelligent automation phenomenon.

### Robotics technology in 2020

- **Microbots allow** emergency responders to explore environments that are too small or too dangerous for humans or larger robots; deploying them in "swarms" compensates for their relatively limited computational ability.
- **Exoskeletons** allow users to augment their physical strength, helping those with physical disabilities to walk and climb, it also finds application in the military.
- **Body-machine interfaces** help amputees to feed-forward controls that detect their will to move and also receive sensorial feedback that converts digital readings to feelings.
- **Modular robots** bring forth LEGO® like robotic cubes that can arrange themselves in preset patterns to accomplish specific tasks.
- **Intelligent robots** combine artificial intelligence and machine learning technologies to give robots human-like expressions and reactions.
- **Robotic strength** increases as elastic nanotubes give robots muscles that are more compact and stronger than human muscles; allowing robots to outrun and out-jump humans.

- **Alternately powered robots** use sources like solar, wind, and wave energy to be powered indefinitely and open up applications in areas that are off-grid.
- **Robotic networks** emerge and allow robots to access databases, share information, and learn from one another's experience.
- **Telepresence robots** act as your stand-in at remote locations saving business travelers both time and money.

- **3D printing minibuilders** combines robotics and additive manufacturing; the process involves fully mobile robots lay down layers of material one at a time and work together to construct objects of virtually any size. These 'minibuilders' are under development at the institute for Advanced Architecture of Catalonia (IAAC) based in Barcelona.

The rehabilitation robot market grows 40-fold between 2014 and 2020, fueled by advancements in rehab/therapy robots, active prostheses, exoskeletons, and wearable robotics.

### Additive Manufacturing (3D Printing)

Developments in "additive" manufacturing, or 3D-printing, spur a second industrial revolution. Falling prices for 3D printers, coupled with growing expertise and new applications, increase the demand for and availability of this technology. Goods become significantly cheaper, high customization becomes the norm and labor costs fall dramatically—factors that begin to reverse the trend of outsourcing to Asia. The DIY nature of 3D printing gives rise to increased intellectual property theft; by 2018, 3D printing may result in global IP losses of at least \$100 billion annually. "Bio-printing," the use of 3D printers to produce human tissues and even organs, becomes feasible.

#### Additive manufacturing in 2020

- **Mass customization** and personalization of consumer goods becomes a reality with 3D printed toys, shoes, cosmetics, and even food products like chocolates and meats that have "print at home" purchase options.
- **3D concrete printing** transforms architecture, with the possibility of 3D printed concrete structure and buildings.
- **4D printing** produces responsive or "smart" objects that self-assemble or shape-shift when exposed to different stimuli.



# Mega Shifts

## Mega Shifts

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By 2020, governments are embracing a new approach to service delivery. Many adopt the role of a solution enabler, creating environments in which innovators thrive and technology-equipped citizens can serve themselves. Open data, crowdsourcing and the co-creation of services herald the shift to distributed governance. Predictive analytics, behavioral psychology and outcome-based regulation translate into smarter decision-making and better governance.

Government's talent model undergoes a radical transformation, creating a more open, mobile and dynamic workforce. And evolving societal attitudes on how we define success and well-being lead to the emergence of alternative measures of prosperity and progress that reach beyond simple gains in GDP.

### Government as solution recruiter

#### Growth of non-state problem solvers

Millions of new players enter the societal problem-solving arena. A government-dominated model of public service delivery shifts to one in which government is just one player among many, including not-for-profits, private corporations, social enterprises, and ordinary citizens.

#### Government as enabler

Public-private partnerships and triple-bottom line businesses that pursue social and environmental goals as well as financial ones become the status quo. In this environment, government's role pivots from chief provider and administrator of services to enabler: the creation of environments in which society's innovators can thrive. The most successful governments build platforms, hold partners accountable for targeted outcomes, open up services to choice and manage crowdsourced campaigns and competitions.

### Multi-trillion-dollar capital markets for social outcomes

"Mutual advantage" and "shared value" are no longer obscure buzzwords, but fundamental business strategies. Businesses around the world address social and environmental problems with sustainable business models. Impact investment, once a niche model, goes mainstream thanks to market-building efforts such as the UK's Big Society Capital fund and India's Inclusive Innovation Fund. Businesses, governments and social enterprises work together to test, hone and replicate investment models that produce robust financial returns and social and environmental impacts.

#### Franchises for public services

Social entrepreneurs adapt the franchising model to consistently deliver superior outcomes, particularly in the developing world. Businesses franchise quality services, scaling them to hundreds of millions of underserved citizens. What began in India and East Africa with schools and healthcare spreads throughout emerging markets and developed Western nations alike.

Bridge International Academies, founded in 2007, created the highly repeatable "school-in-a-box" model in the slums of the Nairobi, Kenya. The low-cost model created schools that allowed local managers to operate at an extremely low cost. By 2014, Bridge International Academies had grown to a network of more than 200 private schools with over 50,000 students spread across Kenya.



### Triple-sector innovation incubators

Physical and online innovation spaces allow government workers, private employees and social entrepreneurs to work side by side, collaborating to create new solutions. These incubators further blur the boundaries between sectors.

### “Made-for-me” service delivery

#### Technology-enabled self service

The burden of delivering many basic services shifts from professionals to individuals wielding technology. A new car owner prints out DMV forms at home. A parolee checks in via ankle bracelets. Tools that help users solve their own problems redirect the expert’s valuable time toward cases that actually require their particular expertise. Advanced, integrated self-service mobile apps and kiosks automate tasks such as municipal payments, the issuance of marriage certificates, passport scanning and probation check-in.

#### Government as food truck

Governments go 100 percent mobile, digitizing as many services and programs as possible. “Mobile first” is standard operating procedure for introducing new online services. Taking a cue from the food truck revolution, the bulk of services requiring face-to-face contact are available via mobile government units.

#### Consumerization of public services

Enterprising startups offering inexpensive, tech-based services that focus on seamless customer experiences generate demand for similar public services. The wave begins in transportation, education and healthcare. Just as Uber and Lyft reinvigorated transportation, entrepreneurs develop innovative and radically user-friendly approaches to satisfy unmet consumer demand for better public services. This trend is visible at almost every turn.

Government services follow the lead of the retail energy sector, in which companies such as Simple Energy and Opower use analytics to transform otherwise esoteric data into digestible and actionable information that encourages customers to save energy.



### Borderless markets for public services

Border-agnostic marketplaces emerge in healthcare, education, job training and other categories of public service. Some governments outsource service delivery to nations or multinational companies with strong brands and track records. Governments with best-in-class systems in specific areas help other governments implement their models. Citizens also search for superior service, engaging in “medical tourism” and educational travel across the globe.

### Distributed governance

#### Distributed problem solving via technology

The accessibility and affordability of social, mobile and cloud technologies allow groups of ordinary citizens to chip away at tough societal problems by the hundreds, thousands or even millions. This technology-enabled approach to problem solving takes many forms, including micro-tasking and micro-volunteerism, crowdsourcing, peer-to-peer models and prize challenges.

#### Crowdsourcing Policy

Crowdsourcing opens once-exclusive decision-making to ordinary citizens. When drafting legislation, governments invite citizens, businesses and social enterprises to provide input via sophisticated platforms that use game mechanics, personalization and analytics to optimize the input of each contributor. Together, they develop policies that are better researched and designed and broadly supported by the public.

#### Co-created policy and services

Engagement in politics increases, as the citizens who experience a policy’s impact most directly work alongside its designers. Carefully designed co-creation approaches allow policy designers to build better prototypes and test them more realistically, increasing the final policy’s effectiveness.

## Open data platforms 2.0

Millions of government data sets have been opened to the public, benefiting a bewildering diversity of community projects. The systems developed for open data programs also become platforms for documenting and rectifying corruption.

## Shareable cities

In cities around the world, the peer-to-peer philosophies of “access over ownership” and “value unused is waste” reach a cultural and commercial tipping point. Rideshares relieve congestion. Food sharing reduces food waste. Skill sharing improves job competitiveness. The growth of collaborative consumption, which turns underutilized products into on-demand services, changes how cities function, from transportation and education to water and energy supplies. Sector-spanning sharing solutions reduce pressure on public infrastructure and services, making the zero-emissions city possible.

## Micro-tasking work

“Micro-tasking” approaches, which employ technology platforms to distribute small, discrete tasks to online workers, are a standard practice for accomplishing government goals. Governments use such platforms to harness the knowledge and skills of citizens and their own workers across multiple departments and agencies.

## Alternative funding models

### Revamped infrastructure pricing models

Dynamic pricing and pay-as-you-go systems replace the blunt pricing models of the past. Governments begin letting citizens pay for services they use. Multiple forms

Crowdfunding sites, such as education-focused giants [donorschoose.org](https://www.donorschoose.org) and [adoptaclassroom.org](https://www.adoptaclassroom.org), reduce some of the pressure on government for capital improvements and serve as models for other services.

of dynamic pricing such as dynamic tolling and parking ensure a balance between the supply of and demand for infrastructure services. Alternate funding models such as mileage-based user fees (MBUFs) emerge, charging drivers based on how much they drive rather than how much gas they buy, and gradually replace the gasoline tax.

## Unbundling services

In 2020, many neighborhoods crowdfund their own needs, from park improvements to private security. Governments unbundle certain services, such as higher education.

## Mini-payments

With digital currencies and mobile payment companies such as Square and Stripe, citizens begin to pay for services on the go, as with today’s widely used “EZ Pass” payments used on toll roads. Building on the initial success of phone-based digital currencies such as M-Pesa, governments extend the ability to make small, direct user payments for a wider variety of public services such as parks and recreation and public health.

## The rise of patient capital

Championed by nonprofits such as Acumen Fund, “patient capital”—investments in early-stage enterprises offering longer time horizons for returns—goes mainstream, even affecting venture capital strategies. This unlocks a sea of private money for ambitious, previously untouchable infrastructure projects such as Elon Musk’s Hyperloop and housing and community development projects. More and more investors shift from seeking quick exits to funding ideas that create sustainable value and solve sticky problems. This has radiating effects on corporate R&D, as corporations join governments in funding groundbreaking research.

## Pay for performance

Fiscal restraints yield an array of innovative funding structures for services and infrastructure. Once-exotic payment-for-results models such as social impact bonds and tax increment financing (TIF) are increasingly popular for financing big, costly development projects and services. Flipping the model and moving some financial risks from governments to investors and contractors is a central characteristic of this global trend.

## Moneyball for Government

### Preemptive government

Data-driven public policies help governments shift resources to where they are needed most. Outside analytics experts routinely are engaged to develop predictive algorithms for decision-making. Predictive models, as well as other types of data analysis and visualization, allow the public sector to focus more

efforts on prevention rather than reaction and remediation. For example, rather than simply reacting to custodial parents calling in to report they are not receiving child support, a predictive model can alert enforcement officers ahead of time about the noncustodial parents who are likely to go into arrears. This model can allow the agency to address the situation quickly, and possibly even prevent the noncustodial parent from going into arrears in the first place.

#### **Targeted transparency**

Open public and private data drive transparency from the bottom up. Individuals and consumers demand government and corporate disclosure. Citizens' transactional data is made available to them in industry-standardized, machine-readable formats so that they can build "choice engines" that help them make better purchasing and life decisions. Targeted transparency as a policy ensures that information disclosed is valuable, actionable and directed toward improving individual decision making in the marketplace and political arena.

#### **Using math to change social behavior**

The science of social networks is applied to social challenges such as reducing obesity, improving education and preventing disease. Since social ties are often more powerful than market incentives in shaping behavior, social network incentives are used to encourage certain healthier, safer behaviors.

#### **Psychology influences policy**

Insights gleaned from behavioral economics, psychology and analytics equip governments to tackle complex issues and affect citizen behavior without significant economic regulation or penalties. Consider, for example, the psychologically motivated line in a tax-collection letter: "Did you know that 90 percent of your neighbors

paid their taxes on time?" Similarly, psychology suggests that people are more likely to act in a certain way if the desired option is the simplest. The tricky part is presenting choices in such a way that citizens are encouraged to make better decisions without impinging on their freedom of choice.

#### **Beta government**

Reform-minded governments apply the agile software development model to policy. Policies undergo rapid iteration and scaling to meet shifting needs, through small prototypes and pilots, staged rollouts and error allowance. Complex systems simulation studies are used to anticipate potential problems and unintended consequences. Policies are regularly tested using randomized control trials to test their efficacy. Insights garnered from small failures during the experimental stage avert larger failures down the road.

#### **Outcome-based regulation**

Digitization and big data analytics improve regulators' ability to track performance and outcomes, enabling them to shift from a concentration on processes to the achievement specific of targets. This allows those regulated to modify and adapt their approaches without falling on the wrong side of the law, while giving regulators a clearer view of the ultimate outcomes.

#### **Just-in-time civil service**

##### **GovCloud**

Governments apply the consulting staffing model to their workforces. Permanent employees undertake a wide variety of creative, problem-focused work in a virtual staffing cloud. Government workers vary in background and expertise but exhibit traits of "free agents"—self-sufficiency, self-motivation and a strong loyalty to teams, colleagues and clients. Teams form and dissolve as needed, allowing civil servants to focus on specific project outcomes rather than ongoing operations.

##### **Governments join the open talent economy**

Rapid globalization, technology advances, geographic mobility and innovation in education are transforming the concept of work. Governments expand their talent networks to include "partnership talent" (employees who are parts of joint ventures), "borrowed talent"

The UK government's Behavioral Insights Team (Nudge Unit) applies insights from academic research in behavioral economics and psychology to public policy and services. The unit has worked on multiple pilots with positive changes in public behavior in areas such as job center services, car tax late payments, and non-payment of court fines.

(employees of contractors), “freelance talent” (independent, individual contractors) and “open-source talent” (people who don’t work for you at all, but are part of your value chain and services). This shift from a closed model to an open, more inclusive one redefines what “workforce” actually means.

### Careers as patchwork quilts

Mobile workforces and the increasingly distributed nature of work break up the 40-year career into a personalized patchwork of different jobs and projects. Workers are motivated more by project-based work that advances their knowledge and less by linear pathways dedicated to a single career. The growth of peer-to-peer arrangements has led to the rise of “first jobs,” “second jobs” and “Wednesday jobs.”

### Human side of government

The rapid deployment of digitization, robots and UAVs in the workplace results in a new mix of civil service jobs. Smart technology causes the loss of some types of existing jobs but also generates plenty of new ones while quickening the pace of learning and retraining. Analytics and behavioral insights augment human capabilities. Displaced workers pivot to the new wave of jobs, many of them requiring close human interaction. Core skill sets for these jobs revolve around understanding human motivations and engaging civic and peer networks to address social problems.

### Basis of National Prosperity Shifts

#### Talent: the new comparative advantage

The ability to attract and develop world-class talent emerges as the most critical component of national competitiveness. As such, governments lower political barriers (taxes, social security and immigration requirements) to welcome a new class of global workers. Global demand for skilled workers, coupled with a choosier creative class, has led to new forms of global mobility, including short assignments (year-long posts for minimal disruption), reverse transfers (top performers from emerging markets move to developed markets for experience and skills) and virtual mobility (working in the cloud). Immigration policies begin to resemble corporate HR policies, as nations attempt to steer the flow of top talent to areas of critical need. Terms such as “global citizen” and “global community” assume larger places in personal identities, as waves of innovators travel to distant shores to solve problems.

### Learning and relearning as the key to national competitiveness

Welcome to the age of lifelong learning. A bachelor’s degree used to provide enough basic training to last a career. Today, the skills that college graduates acquire during college have an expected shelf life of less than five years. The lessons learned in school thus become outdated long before student loans are paid off. National competitiveness may face no bigger challenge than the accelerating cycle of obsolescence. More than almost any other factor, national competitiveness becomes a matter of how to rapidly train and retrain vast numbers of people on an ongoing basis.

### Economic indicators redefined

Automation, robotics and the growth of peer-to-peer services decouple productivity and conventional employment. To accurately assess the economy and promote its growth, companies share data with governments, while new metrics account for a new class of tech-enabled workers, including micro-entrepreneurs driving for Uber, crafters selling on Etsy and Airbnb hosts. More expansive metrics overturn legacy notions of “joblessness.” Regulators begin to shape a more supportive climate to nurture new classes of workers and services.

### Alternatives to GDP take hold

The importance of GDP as a determinant of a nation’s progress begins to wane, making way for more holistic measures of progress and well-being based on measures such as personal safety, ecosystem sustainability, health and wellness, shelter, sanitation, equity, inclusion and personal freedom. As nations grapple with global challenges including climate change, chronic disease and rising inequality, the shift towards more multi-dimensional indicators represents a broader change in attitudes toward defining and measuring success.

Bhutan, a tiny country at the foothills of the Himalayas, moved away from measuring national prosperity through the GDP lens way back in 1971. Instead it measures prosperity through a unique metric called Gross National Happiness (GNH). The GNH measures prosperity through the spiritual, physical, social, and environmental health of its citizens and the natural environment.



# Trends



## Education 2020

Step into the classroom in 2020 and see powerful forces at play. A global shortage of skilled talent propels career-focused learning. Virtual learning, digitization and augmented reality have made our old definitions of a classroom obsolete. Evolving learning needs redefine what education means, who delivers it and how. Students become teachers, learning from one another through project-based learning and self-organized learning environments. Education funding shifts to pedagogical approaches proven to work via real-world trials. Unbundled, personalized and dynamic education is the new normal.

### The classroom of the future

#### Digitized classrooms

Digital technologies pervade almost every aspect of the classroom, with enhancements such as desk-sized screens, tablets that track eye movement and thus attention, performance dashboards, object-embedded intelligence and interactive whiteboards.

### The Maker Classroom

3D printing makes its way into the classroom, allowing students to transform their ideas into actual models and test them, a practice already followed in manufacturing. 3D printing fosters creativity, innovation and an interest in science and math. By 2020, the classroom has evolved into a creative space enriched by 3D printing, robotics and real-time collaboration with community startups.

The global mobile education market grows to \$37.8 billion in 2020, up from \$3.4 billion in 2011.

### Virtual laboratories

Students perform virtual physical science experiments with nothing more than Internet access. While these applications can't replace all real-world experiments, they can provide extra practice, guidance and safety at a considerably lower cost. They also allow students to learn by making mistakes, sparking interest in the scientific method.

### Classroom or playroom? Now it's both.

More and more schoolwork is game-based, allowing students to learn through playing, building and discovery.

### Education technology mash-ups

The mash-up of different technologies, such as robotics, 3D printing and programming, results in big changes in education. Organizations emulate the approach of Play-I, which is crowdfunding its robot Yana (which stands for "you are not alone"). An interactive iPad app teaches kids to program the robot to perform simple tasks. The objective is to make kids the creators and directors, not just the consumers, of technology. Over time, kids will build their own complex tasks and moves for the robots and share them with the broader Play-i community.

### The augmented classroom

Augmented reality (AR) applications become a common feature of interactive learning in schools, transforming a static learning experience into something immersive and dynamic. For example, instead of looking at diagrams in a book, a student learning about the human circulatory system points an AR-supporting device at a classmate to visualize her heart beating.

### Next-generation teachers

#### A new teacher-student relationship

Telepresence, algorithm-generated lessons, teacher assignment algorithms, assessment algorithms, mobile learning platforms and student-to-student teaching platforms all become part of most classrooms in developed countries. Overturning traditional teacher-student models, these technologies allow teachers to focus on teaching while artificial intelligence helps personalize the lessons.

### Robot teaching assistants

Classroom robots learn from every interaction with humans and accumulate knowledge. Fully autonomous, guided by artificial intelligence software and features such as motion tracking and speech recognition, the robots help young students learn simple skills while adapting to their psychology. For example, no child likes to admit his or her own mistakes but may be happy to correct someone else's; robots can be programmed to make carefully calculated errors when working with students, who learn while correcting them. Robots won't replace human teachers; instead they serve as effective teacher helpers.

### Rise of the hybrid teacher

The career path for teachers evolves. Many teachers increasingly serve in hybrid roles, teaching in the classroom half time and devoting the rest of the day to activities such as researching teaching methods, coaching teacher candidates or working with district administrators on community outreach programs.

### Teachers who can "read minds"

Face-coding algorithms help teachers learn from students' facial expressions. They can know when students are confused or struggling with a concept, and even gauge the expressions of autistic children. Facial coding also improves online education. Advanced neural headsets will allow teachers to actually "read" students' minds—a red beeping light warns of students whose focus and attention have dropped below acceptable levels.

### The evolution of learning

#### Personalized learning for everyone

In the online world of 2020, students have unprecedented access to learning resources around the globe, largely without reference to barriers such as time, location and institution. Academic analytics and facial coding technology are built into online learning environments, enabling real-time assessment and personalization of content. Most students have their own digital learning profiles recording their skills, knowledge and credentials throughout their lifetimes. These profiles are updated automatically based on learning and career experiences.

### Self-organized learning environments (SOLE)

Self-organized learning environments (SOLES) give students more control over what and how they learn.

Education researcher Sugata Mitra gave children access to a computer and the Internet through a space in the wall of his office in a Delhi slum. He saw how the children, despite not speaking English or even attending school, taught themselves how to find information they needed online, accidentally discovering interests such as genetics. His concept of a “school in the cloud” is essentially a computer lab open to children that allows them to explore their interests, supported by the encouragement of online volunteer mentors who intervene when needed.

### Cognitive calibration in the classroom

By 2020, students at the best schools each have cognitive profiles that inform their individual learning plans. Uncovering this information is relatively expensive, however, and wealth disparities create disadvantages for some.

### The student becomes the master: peer-to-peer learning

Students learn from each other through project-based learning and collaboration. Students who test well for personality compatibility, but have varied cognitive strengths, are paired up to support one another during the year, maintaining a constant connection amid changing peer relationships. Thanks to technology, such collaboration is no longer limited to peers in a single class, school or country.

### School Systems 2.0

#### Marketplaces for learning

Educational markets grow both within and outside public school systems. With the democratization of entrepreneurship via crowdfunding platforms, incubators, startup mentor networks and innovation summits, the education ecosystem sees a burst of new ideas, technologies and learning models.

### Unbundled education

Many jurisdictions see the “unbundling” of education, the breakup of the composite structures comprising schooling today. Schools take on the role of a connector or general contractor and convene different organizations that excel in teaching various subjects, rather than every subject. This allows teachers to specialize and bring a higher level of expertise; a teacher might, for instance, be hired to teach human anatomy to eighth graders, rather than general biology to all middle-school grades. These freelance “teacherpreneurs” rotate between multiple schools. The unbundled education system provides greater room for creativity, taking the basic elements of education and reassembling them in a way better suited to the evolving needs of learners.

See GovCloud

### Next-generation apprenticeships

The success of apprentice programs in Germany and Austria, together with the ballooning cost of college, drives the growth of modern-day apprenticeships. Apprenticeships evolve in terms of how they are delivered and become more accessible through the use of technology. For example, the State Department’s Virtual Student Foreign Service employs college students remotely as “e-interns.” Private businesses and government agencies increasingly offer tailored programs to help train and employ skill high-school students. Multinational corporations disseminate successful apprenticeship models to other parts of the world.

### School-business collaboration

Schools and businesses co-produce programs teaching job-specific skills, integrating formal education and employment. Education in 2020 also blends adult retraining and youth education—companies send employees who need retraining back to school with kids learning the skills for the first time. Co-learning fosters the exchange of practical wisdom and fresh ways of thinking between both groups.

Today apprentices make up only 0.2 percent of the US labor force, far less than in Canada (2.2 percent), Britain (2.7 percent), and Australia and Germany (3.7 percent).

## Tomorrow's Curriculum

### From textbooks to flexbooks

The students of 2020 play a role in the creation and construction of their own learning materials. Heavy, expensive and quickly outdated textbooks are replaced by cheap, easy-to-update, interactive, digital “flexbooks.” The authors of digital texts often are teachers—and sometimes students. With project-based learning, students and teachers around the world become the source of more and more open-source materials.

### Kindergarten coders

Building on the cognitive skills of digital natives and “iPad babies,” children are introduced to coding for computers early—preferably in elementary school. Curriculum and teaching methods evolve quickly to keep pace with the continually advancing needs and abilities of even the youngest learners.

Estonia has begun introducing children as young as six to the basics of coding.

### New definitions of literacy

The rapid acceleration of technology gives rise to new dimensions of literacy. Because new technologies engage the learners’ senses and offer a more immersive learning style, literacy becomes defined by critical thinking, creative thinking, calculation and “compspeak”—the skills needed to access information using computers equipped with natural language recognition. Schools in 2020 also teach emotional and social intelligence. Equipped with a deeper understanding of themselves and others, students more easily transition into adulthood and seek out career paths best suited for their cognitive strengths.

### Museums as learning hubs

In 2020, museums are vibrant places that constantly experiment with new ways to use their collections to enhance learning. With technologies such as augmented reality, sensors and 3D printers, museums provide students with an immersive learning experience on topics including history and science, while also teaching skills such as teamwork. Museums and other public spaces act as equalizers, giving everyone access to the same learning resources and technology.

## Higher Education

### Rethinking career pathways

Rather than allowing the latest list of rankings to guide their college decision-making, students instead start with the end in mind: what do I want to do? Thanks to organizations such as LinkedIn, which provides free access to aggregated education and career data from its vast network of members, it’s never been easier to map the career pathways of hundreds of millions of professionals so that students can reverse engineer the college decision-making process. Rather than “where do I want to go?” as the jumping-off point, students instead start with their desired career outcome in mind and can study the varied paths other professionals took, including the skill sets required for success.

### A shift from credit hours to competencies

Competency-based degrees emerge as a popular alternative to traditional degrees awarded on the basis of completing a certain number of credit hours. Competency-based degrees are self-paced, reward prior experience and measure learning through demonstrated proficiency, making them very attractive to students seeking a degree from a well-recognized institution at a fraction of the cost of an equivalent in-person degree—and with less time spent out of the labor market.

### Design your own career pathway

Alternative education providers such as HackReactor, a San Francisco-based “bootcamp” focused on teaching computer programming in an immersive training environment, offer students an accelerated path for acquiring in-demand skills sought by employers. Thanks to a growing ecosystem of such educational providers, students in 2020 have many alternative pathways for upgrading their skills and advancing their careers.

### Stackable educational credentials

As alternative education providers proliferate, businesses need a means of comparing the relative merit of various education credentials (e.g., How does a 12-week General Assembly course stack up against a four-year college degree?). In 2020, it’s possible to make quick apples-to-apples comparisons across an increasingly diverse educational landscape enabling employers to assess the rigor of each individual’s unbundled education.

Education technology start-up Degreed assigns scores to a full range of educational opportunities, from massively open online courses to college degrees to corporate training.



## Energy and Environment 2020

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Conversations on energy and the environment center on the three Cs—connect, collaborate and coexist. Smarter devices result in smarter energy choices, while networks of sensors, drones, citizen regulators and conscious consumers work together to monitor and protect the environment. Rapid urbanization fuels innovation and the quest for sustainable and resilient cities. Entire markets emerge around sustainable solutions such as reducing food waste. Government regulation is less blunt—and heavily influenced by sensor-produced data.

### Smarter data and devices lead to smarter choices

#### An application layer for the smart grid

The combination of remote sensing, metering and real-time pricing connected to applications that give businesses and consumers greater control over how they use energy—or automatically make the best decisions for them—leads to innovative new services. This “application layer” becomes the locus of innovation and profits in the energy space; on it, organizations build everything from sustainability apps and interactive electricity bills to distributed micro-power grids. Integration with smart grid systems gives utilities greater flexibility to “surgically” balance demand and load, providing more opportunities for consumers to participate in demand-side management programs. This requires education and coordination with state regulatory bodies that approve energy efficiency programs.

#### Energy-saving learning devices

Smart, networked devices like the Nest Learning Thermostat are increasingly the norm for everything from household appliances to handheld electronics. These gadgets know you better than you know yourself, studying your habits and patterns to find the most optimal ways to use energy. By 2020, most consumers buy Nest-style devices as part of bundled “home energy management” offerings. Governments work to balance the inequality between citizens who can afford to generate or negate their energy use via solar and smart devices and those who cannot

### Gamifying sustainability

Utilities and developers leverage the data of the smart grid to drive end-user behavior. In particular, “gamifying sustainability,” using games and game mechanisms to encourage energy conservation. Companies work with consumers and utility companies to track and analyze home energy consumption and present the data to consumers in ways that encourage them to save power.

### Environmental data go hyperlocal

Government employs sophisticated geospatial analytics to improve land management, using analytical tools and techniques to examine the relationships between a number of factors, including highly localized data on rainfall, surface elevation, soils, geology, drainage and historical flood patterns. Such data equip agencies to identify at-risk areas and improve their defenses against natural disasters. The data also better inform infrastructural requirements and help government target investment.

Nest is designed to learn based on users’ schedules, and optimize energy use and savings. The thermostat can be programmed remotely by mobile phone and can reduce heating and cooling bills by up to 20 percent.

## Environmental monitoring at your fingertips

### Embedded environmental sensors

Embedded sensors of various types are used for everything from pollution monitoring to land management, supplementing or replacing on-site inspections. Energy agencies rely on these sensors for continuous environmental monitoring and automatic intervention. These technologies help agencies execute their missions, but also raise issues concerning the definition and resolution of violations in a real-time monitoring environment. Embedded sensors in “smart cities” enable continuous monitoring of weather conditions, air quality and home energy consumption.

BCC research estimates that the global environmental sensor and monitoring business grows from \$13.2 billion in 2014 to nearly \$17.6 billion in 2019, at a compound annual growth rate (CAGR) of 5.9 percent.

### Drone environmental monitoring

Drones are commonly used for land monitoring, pollution control and related activities such as “smart” agriculture. Hurdles are encountered, in particular the regulation required to quell privacy and security concerns around non-military drones. Agencies such as the Coast Guard struggle to maintain adequate presence and domain awareness over their vast areas of responsibility; drones act as a substantial force multiplier.

### Hyper-localized environmental enforcement

Aided by embedded sensor networks and intelligent algorithms that provide only important data to human analysts, governments gain the capability to enforce regulations at a hyper-local level, driving greater compliance with environmental laws. They also leverage predictive models as a kind of force multiplier, using data to profile regulated organizations and identify which are most likely to be negligent. Third parties also get into environmental monitoring. Efforts are made to integrate data from environmental advocates and third parties with government data to create a more holistic view of the current state of the environment.

### Citizen regulators for environment

Niche groups of citizens with increasingly powerful tools, social and otherwise, become formidable civic and environmental crusaders. These “activists by night”

undertake distributed monitoring and protection of the environment, organizing through websites such as witness.org. They also participate indirectly, opening up the sensors in their mobile devices and homes for use in large-scale monitoring programs. Citizen regulators play an increasingly important role in building or breaking a project’s social license to operate.

## Connect, collaborate and co-exist

### Food Sharing

“Food sharing” transforms our interaction with the environment by localizing food production and consumption. In the process, our food systems become more resilient, decreasing the incidence of mass recalls and food-borne disease. Governments rethink how they inspect and regulate food quality as food sharing grows.

### Everyone is a utility

A new class of citizen power producers uses homes and offices to generate electricity and sell extra capacity back to the grid. Buildings increasingly are covered with solar material and paper batteries, transforming the construction industry and creating millions of new micro-sources of power. One potential roadblock is the role of regulatory agencies, which may limit who can legally “sell” power.

### Sustainability lessons from the base of the pyramid

The world looks more and more to people at the margin, who often already operate in an energy-lean fashion to save money. These groups, including slum dwellers, refugees and citizens of developing nations, serve as a source of innovation as well as powerful evidence for the use of personal self-interest to drive sustainability.

See: Another Billion

### Environmental mission convergence

With environmental concerns rising, the missions of various public and private organizations converge, to the point that, in some jurisdictions, nearly everything falls under the umbrella of an energy or environmental organization. New technologies such as “pervious concrete,” which allows storm water to pass through, reducing runoff and the need for costly storm water management, usher in an era in which environmental agencies start thinking like transportation agencies, and vice versa.

Bernstein’s analysts predict new worldwide solar installations will grow from just 31 GW in 2012 to 300 GW a year by 2020.

## Sustainability solution markets

### Future impact bonds for sustainability

With the rise of big data and analytics, environmental and sustainability programs can be evaluated holistically, considering both direct and downstream impacts. For example, air quality initiatives that seem costly may actually save significant amounts by reducing pollutants that lead to respiratory illness and thus hospital visits. To fund these kinds of efforts, governments issue “future impact bonds,” allowing them to raise capital to address underlying social and environmental problems in exchange for a share of the downstream rewards.

### Collective action” on sustainability issues

As the sustainability agenda gathers steam, global firms partner with social organizations. “Collective action” is the new buzzword: the government, private sector, social organizations and innovators come together to build solution ecosystems around environmental issues.

In Tanzania, a unique alliance is working to improve the country’s generally low agricultural productivity. The goal of the Southern Agricultural Growth Corridor of Tanzania (SAGCOT)—whose partners include Unilever, the fertilizer company Yara International, SAB Miller, Monsanto, and the government of Tanzania—is to create an efficient agricultural value chain, with the expectation that it will triple the area’s agricultural output.

### Market externalities become market opportunities

The private sector moves away from treating sustainability as part of the CSR/philanthropy portfolio and instead works to create shared value with its customers and community. Firms still strive to meet their profit goals, but pursue sustainable development models, which create greater value for the company and community in the long run. In India, for example, Unilever has created a campaign around washing hands, which increased the sales of its soap while reducing cases of diarrhea due to better hygiene.

### Credits as currency

As environmental protection laws continue to evolve, so do credit markets. New exchanges emerge in various facets of sustainability, with credits being traded as currency—carbon credits, water quality credits, fishing quotas and net energy credits, to name a few. This spurs the creation of viable markets that protect both people’s livelihoods and the environment.

### “Aspirational” drive sustainable consumption

Today, more than a third of the US population is classified as “aspirational,” focused on responsible consumption. By 2020, these consumers usher in a tectonic shift in the sustainable marketplace. Armed with better data about corporate practices, they buy products only from companies with green reputations, crowning new industry leaders.

### Rebalancing the “green versus growth” equation

Fossil fuels continue to dominate energy markets because 6 billion people living in the developing world want rapid economic growth through proven, scalable methods with very low upfront costs. To tip the scales in favor of green thinking, policymakers create new incentives and mechanisms such as environmental impact accounting and “un-development” policies that price in the true cost of carbon.

## Urban environmental innovation

### Kickstarting innovation in energy and environment

With no clear path forward in the energy field, investors and government agencies double down on their efforts to uncover promising new technologies and approaches—and help rapidly scale those that show potential. To support this effort, agencies increasingly rely on new tools and methods to identify and support innovators. Crowdsourcing and crowdfunding platforms focused on energy solutions emerge as a promising way ahead.

### Sustainable, resilient cities

Early innovations in green building seen in the first decade of the 21st century become the norm, reshaping the construction industry and creating entirely green cities that are not only sustainable, but resilient, giving rise to advances such as zero-energy home building, rooftop farming and permeable pavements.

### Recycled construction

As the cost of raw materials continues to rise, “taking it out of the ground” is no longer feasible for most construction projects. Instead, developers increasingly source metals and minerals from old buildings, landfills and junkyards, fueling a surge in the secondhand market.

The global Construction and Demolition Recycling market grows to \$23.85 billion by 2020.

### Rise of materials makers

Given high costs and supply constraints for key material resources, companies increasingly turn to labs for “designer molecules” they can use as replacements. These “materials makers” become critical to manufacturing, helping to keep costs low and reducing the negative environmental impacts associated with traditional sourcing. Regulatory agencies have to adapt and widen the scope of their testing, policy and enforcement efforts to keep up.

### Innovation in food production

Climate change and natural calamities disrupt global food production, driving the need for innovation in food production. Widespread urbanization and the degradation of arable land give rise to “vertical farms” inside cities to meet food demands. Globalization of taste and increased consumption of meat put pressure on food and water systems. Conscious consumers push for healthy and organic food, sustainability and reduced food footprints, while burgeoning ecosystems develop around food waste recycling and the redistribution of unused food. As oceans and rivers deteriorate, aquaculture becomes the primary source of fish for human consumption.



## Health Care 2020

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The dominant healthcare trend in 2020 is, quite simply, pervasiveness. Mobile health apps, telemedicine, remote monitoring and ingestible sensors generate rich data streams, allowing doctors and patients themselves to track every heartbeat, sneeze or symptom in real time. Bioinformatics and analytics allow for personalized risk assessments and tailor-made medicine. Breakthroughs in robotics, 3D printing and stem-cell research make surgical procedures safer and improve outcomes. Healthcare systems shift their focus to wellness and prevention to compete against insurgent competitors.

### Patient-powered healthcare

#### “Tailor-made” medicine

The use of bioinformatics in health care grows exponentially. Based on human genome sequencing and body composition, custom medicines and treatments are developed and prescribed to patients. This helps treat dreaded illnesses such as cancer and genetic disorders—where failure rates of medicines are historically high. Government closely oversees research, testing and therapeutics, regulates accuracy and affordability, and plays a centralized role in determining best practices for treatment plans.

#### Personalized health risk assessment

Medical compliance rates increase seven-fold due to personalized health assessments. Personalized risk assessment increases patient compliance with medical treatments—patients with a genetic risk diagnosis, such as familial hypercholesterolemia, show nearly 50 percent higher compliance with treatment. Some governments make such assessments compulsory for some beneficiaries in order to achieve better health outcomes and reduce costs.

#### The mHealth revolution

Mobile technology proves to be a game-changer for healthcare. The ubiquity of mobile phones and growing health needs make “mHealth” an affordable and easily accessible alternative to traditional healthcare. Advanced mHealth applications include telemedicine, sophisticated diagnostics through attachments plugged into smartphones, personalized services and self-

monitoring. Governments address security and privacy abuses from the growth of mHealth. They also allow students to learn by making mistakes, sparking interest in the scientific method.

#### Social media, the new health exchange

Healthcare organizations engage with patients through social media, regularly gauging their needs and driving them to appropriate products and services. Online patient communities grow exponentially and become rich databases of crowdsourced data. Advanced analytics on patient chatter in these communities gather health information and put it into context, providing a better understanding of which treatments deliver the best outcomes. Businesses and governments work with communities of patients, hospitals, payers and experts to identify best practices and cost-effective treatments. New business models emerge with this rise in cross-organizational cooperation and collaboration, driving down costs and improving care. Privacy and security of data remain key considerations.

#### The quantified self

Thanks to digital and mobile health technologies, patients assume a bigger role in addressing their healthcare needs. Sensors, smartphone attachments and sophisticated mobile applications begin to replace the traditional checkup, tracking everything from heart rate and calories burned to sleep patterns. Self-tracking data make individuals more receptive to behavioral nudges and are used by policymakers and insurance providers to reward healthy lifestyles.

## The data revolution

### Social media analytics in health care

Anonymized data from social networks are used for biomedical research, personalized medicines, clinical trials and the construction of predictive models. Advances in health-focused, natural-language data processing allow analysts to use big data to identify the decisions patients make and, more importantly, why they make them. Government uses social media analytics to gain insights into patients' consumption patterns and health requirements.

Health care analytics is a \$21 billion industry in 2020.

### Evidence-based care

Doctors use high-end analytics to diagnose and treat patient conditions by mining massive clinical information from electronic medical records (EMRs). Analytical tools take into account patients' genetic profiles to suggest the best treatment options and explore alternate treatments based on the experiences of others with similar symptoms and genetic profiles. Sewage analysis is used to predict likely health conditions caused by pathogens and prepare in advance to prevent major outbreaks. 2020 sees the creation of warehouses of health data that use big-data analytics to identify patterns and inform public health decisions and research.

### Real-time clinical information

Advanced data-sharing networks allow payers and providers to access real-time patient information. This allows health plans to assess the quality of care offered based on patient diagnosis and treatment. Government mandates and incentives promote the adoption of data sharing and allow government to serve as a centralized health information exchange.

### Participatory medicine

Patients use their own health data to make better decisions. Patient-centered information networks, such as Crohncology for Crohn's disease, help people better manage their health, share best practices with fellow patients and lower medical costs by tapping into the knowledge of the crowd.

## Next-generation care

### Holography-assisted surgery

Specialized surgeons perform holography-assisted surgery to treat patients remotely and instruct other physicians on operating procedures. Holography makes surgery less invasive and potentially offers better outcomes for patients while freeing up surgeon time.

### 3D printing in health care

3D printing technology revolutionizes surgical practices, giving practitioners access to identical replicas of certain body structures—and eventually organs. It reduces surgical errors and improves rehabilitation in post-op. Joint replacement surgeries are cheaper and use customized prints of patient's joints. Medical education uses this technology to create cheaper prototypes for teaching, avoiding ethical issues associated with using cadavers.

### Breakthroughs in stem cell research

Developments in stem cell research lead to the production of synthetic organs and smart drugs to improve physical and mental function. Breakthroughs such as induced pluripotent stem (iPS) cells short-circuit the long debate over the use of human embryos in research and speed up stem cell therapies to cure human disease. Government incentivizes research and development and introduces policy measures to navigate ethical issues hindering widespread market adoption of this tool.

### Remote monitoring

Sensor-enabled remote monitoring devices transmit vital patient biometrics to physicians and other caregivers in real time. 2020 sees the use of ingestible "smart pills" with sensors to wirelessly relay information on health indicators within the body to a smartphone. Doctors can track health indicators more closely and receive precise information about which medications their patients actually took, and when.

### Healthcare robotics

Robots sterilize surgical tools without human intervention, reducing incidences of infections and freeing up hospital staff time. Robotic systems dispense drugs in pharmacies with zero errors while automated kiosks allow patients to enter medical symptoms and receive customized recommendations and information. Automation dramatically reduces errors and helps improve outcomes.

Biopen, developed by Australian researchers, could allow surgeons to directly "draw" stem cell layers on an injury. The pen works like a mini-3D printer and offers surgeons more precision while reducing the time taken for the procedure.

The global medical robotic systems market reaches \$13.6 billion in 2018.

## Healthcare systems

### Expanded definition of health

Healthcare systems evolve from “sick care” to wellness. Nutrition, behavioral, environmental and social networks act as vital health foundations. Health care is defined not by care facilities but by the status of consumers’ health. 2020 sees the convergence of allopathic and alternative medicine, and of physical and behavioral medical management. Government promotes wellness care through incentives, requirements and payment models, particularly in countries where it is the primary payer.

### Integrated care

Accountable care organizations (ACOs), patient-centered medical homes (PCMHs), outcome-based payment models, providers, physicians and payers join together to provide patients with bundled services, providing care at lower cost. Hospital-physician alignment allows prioritized treatment for patients requiring urgent attention. Electronic health records and e-prescriptions improve accountability and transparency. Government encourages integrated care to systematically raise health care standards.

### Communities as health care providers

Aging populations and a growing disease burden raise the demand for skilled healthcare professionals, potentially creating a shortage across the globe. As a result, healthcare systems increasingly rely on community outreach, peer-support initiatives and partnering with patients and families to supplement care. In developing nations, community healthcare workers with little training provide education, support treatment, use diagnostic devices and deliver medicines, allowing specialists to handle more complex tasks.

### Outcome-based payment

2020 sees the growth of value-based care models that link the price of care to the value of the performance or health outcome, holding medical practitioners accountable for the care they provide. The model is driven by performance metrics such as hospital readmissions or patient ratings, and by linking doctor payments to patients’ health.

## Rise of private health insurance exchanges

Private players form a significant part of health insurance exchanges in the US and some other countries. New exchange products supported by technology open new avenues for these players, offering customers more options. Private exchanges match public ones in terms of volume and spread insurance products at competitive prices.

## Healthcare in developing nations

### “Frugal” healthcare.

Universities, medical technology giants and even mobile phone companies begin developing portable diagnostic tools that can be manufactured for just 1 percent of the cost of traditional medical devices. Developing countries pursue a “back to basics” approach to prevent disease, such as washing umbilical cords with antiseptic to reduce infections among newborns. No-frills models such as Aravind Eye clinic and Narayana Hrudalaya in India, and franchise “clinic-in-a-box” models such as Unjani in South Africa, provide affordable care and complement overstretched public health care systems.

### “Nutrition transition” and disease paradox

Globalization, rising incomes and a shift to sedentary work spur the growth of lifestyle diseases in developing countries, including obesity, certain types of cancer, diabetes, strokes and heart attacks. As global fast-food chains expand and cheap, calorie-rich foods become widely available, countries undergo a “nutrition transition,” changes in health, diet and exercise that accompany economic progress. This engenders a shift from curing disease to controlling and managing chronic conditions. Some nations suffer from the paradoxical double burden of inadequate nutrition and obesity.

### Drone-delivered vaccines

Unmanned aerial vehicles deliver vaccines, medical supplies and essentials to remote or congested areas in developing nations via networks for “micro-transportation.” Healthcare workers deploy UAVs via cellphone to deliver vaccines to hard-to-reach locations. Developing nations explore policy measures and enact regulations governing the use of UAVs as the technology becomes mainstream.

### Growth of telemedicine

As the communication infrastructure in developing nations improves, telemedicine extends healthcare—and particularly access to specialist care—to more citizens. Local clinics and practitioners can consult remote specialists via video-conferencing, mHealth applications and remote diagnostic tools. Chinese and Indian companies continue to invest heavily in video-related health technology in parts of Africa. Existing mobile network operators may subsidize telemedicine programs

### Focus on preventive health care

Healthcare systems focus on long-term prevention and management rather than short-term treatment. This is achieved through education and awareness campaigns and behavioral nudges toward healthy habits. For example, public-private partnerships deliver vital health information through mobile phones to mothers in low-and middle-income countries in Africa and Asia. Messages are targeted to each stage of a woman's pregnancy so that the information reflects what she is experiencing, establishing an emotional connection and encouraging healthy behavioral changes.



MAMA is a public-private partnership that supports programs delivering vital health information through mobile phones to mothers in resource-constrained settings in low-and middle-income countries in Africa and Asia.



## Human Services 2020

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Human services in 2020 are customized, data-driven and technology-infused, continually redefined by new possibilities. Governments tap community assets and peer-to-peer support programs to augment service delivery. Behavioral psychology and economics play a larger role in designing interventions, while outcome-oriented social innovation financing helps scale the programs that work.

Mobile technology, sensors and wearable devices enable remote monitoring while virtual check-ins complement in-person interactions. A new breed of caseworker-intrapreneur brings fresh ideas and innovation to human services organizations. Outcome-based funding moves beyond fringe status thanks to advances in measurement, data analytics and large inflows of private and nonprofit funding.

### Calling on community to augment service delivery

#### Peer-to-peer social support

Human services agencies reinvent themselves by taking full advantage of the growing social services ecosystem. Peer-to-peer programs that use a co-design approach to service delivery become more commonplace. The fact that peer-to-peer programs balance agency support with client choice and freedom, while strengthening social networks, drives this trend.

#### Community-powered human service delivery

Government agencies augment their capabilities by tapping community assets including citizens, NGOs and community organizations. Community support becomes a powerful force, particularly in cases where heavy intervention is unnecessary. Problems such as loneliness and social isolation, for instance, can become mental health and substance abuse issues if left untreated; strong social networks can prevent this progression.

Volunteers help strengthen the social safety net through the growth of innovative avenues—time banks such as CareBank, food sharing networks such as Casserole Club and programs that engage communities such as the Philadelphia Department of Human Services' Improving Outcomes for Children are a few examples. Such programs reinforce feelings of responsibility and empowerment within the community. Mobile technology helps mobilize

support.

### **Meet the Caseworker of the Future: Smart, Connected, Intrapreneurial**

#### **Virtual training for caseworkers**

Simulation-based training plays an important role in preparing employees to handle difficult situations they may encounter on the job. Serious “games” such as those developed by the Center for Child Protection at the University of Kent provide a safe medium for professionals to explore and assess child protection situations. Artificial intelligence-based training programs

The Center for Child Protection at the University of Kent has developed Serious Games—a child protection simulation—that helps train child protection professionals on how to handle various situations. The prototypes ‘Rosie 1’ and ‘Rosie 2’ help hone skills on various critical steps in the child protection process.

simulate a range of realistic scenarios for human services professionals at all stages of their careers.

#### **The rise of the connected caseworker**

Human services agencies use technology to break down bureaucratic silos without the pain and expense of reorganizing. Through the use of mobile technology, cloud servers and customized social media networks such as Patchwork, caseworkers connect with other professionals to share information, coordinate services, plan tactics and remain updated on client progress.

#### **Caseworker-intrapreneurs**

Human services workers function as intrapreneurs, bringing new ideas to the organization and assuming responsibility for implementing them. These intrapreneurs receive increased support from their agencies, often through novel means such as internal platforms that allow innovators to post new ideas and solicit pledges of support from other internal entities. These pledges include in-kind contributions,

such as staff time or assistance with testing, or more conventional resources such as the use of space or funding.

### **Help is just a click away: remote monitoring**

#### **Virtual check-ins**

As mobile technology grows ever more ubiquitous, mobile platforms allow caseworkers to conduct virtual check-ins with clients through free tools such as Facetime and other video and live-chat applications, supplementing in-person visits. These tools enable virtual monitoring and more timely intervention.

#### **The avatar will see you now**

In 2020, human services integrate virtual tools into service delivery. Virtual counseling and therapy (where live professionals are replaced by avatars) supplements conventional in-person therapy. Virtual reality is used to treat addiction, substance abuse and smoking; by reacting to cues in a virtual environment, patients can build coping mechanisms that kick in when they encounter similar situations in real life. Virtual methods complement in-person interactions, but do not replace them.

#### **Wearable devices prevent substance abuse**

Wearable mobile health devices detect changes in indicators such as body motions, skin temperature and heart rate, and can predict when the wearer is likely to engage in risky behaviors. These indicators are wirelessly streamed to a smartphone equipped with an app that monitors them, delivering personalized, multimedia drug prevention interventions in real time and alerting caseworkers when in-person intervention is required.

#### **Smart homes for seniors**

Sensor-equipped “smart homes” improve long-term care options for senior citizens, allowing them to live safely in their homes and maintain their independence. These homes recognize and analyze behavior patterns (eating, sleeping, and movement) and report signs of illness or cognitive degeneration to caretakers and physicians. Compared to the high cost of other long-term care

By 2020, the market for continuous glucose monitoring devices aided by wearable sensor technology reaches \$500 million.

options, sensor-enabled smart homes are affordable. For the rising population of senior citizens across the globe, sensors improve their quality of life while reducing the total cost of their long-term care.

### **“Made-to-measure” human services: Customized service design and delivery**

#### **Customer-centric human services**

Rather than asking, “How many services or benefits can I enroll this person in?” caseworkers instead ask, “What is the goal for this individual or family, and which services and benefits would help them achieve it?”. Rather than a one-size-fits-all standard, caseworkers strive to understand individual needs, and then provide the services and benefits most likely to help their unique situations. By segmenting the larger customer population into sub-groups with similar characteristics, safety-net programs are tailored to the unique needs of each group, resulting in better outcomes.

#### **Behavioral nudges in human services**

Recent strides in behavioral psychology and economics lead to the widespread use of techniques that coax clients to alter their behaviors. These “nudges,” actions used to help improve decision-making, are effective in spurring positive behavioral change without substantial investments. Agencies such as the Texas Attorney General’s Child Support Division already use simple tweaks to collection notices—such as removing the logo of the Attorney General and simplifying the language used—to improve collections.

### **Data to the rescue: targeted, analytics-driven interventions**

#### **Geospatial analytics and hot-spotting**

Administrators use geospatial analysis to examine complex data through the lens of place, giving them an intuitive way to make sense of the situation. Organizations such as Fostering Court Improvement use state and local data to map child abuse and neglect “hot spots”—neighborhoods where instances of child mistreatment are especially prevalent. This allows child welfare workers, judges and others to

ask meaningful questions about factors that might be feeding higher rates of abuse, and to focus resources on the neighborhoods—or even particular housing developments—where they’re needed most.

#### **Customer analytics change lives**

Rather than tracking and measuring transactions as a means of measuring success (Did we respond to 95 percent of our referrals within five days?), human services agencies instead gauge the impact of their services on their customers’ lives and futures. With customer analytics, agencies mine their enormous pools of data to better understand and predict client needs, vastly improving the services they provide. By focusing on the demand side of the equation, the business of human services is better aligned to its core mission of improving people’s lives.

#### **Segmentation and intervention driven by lifetime liability**

To better understand the factors and client characteristics driving benefit costs, governments assess the long-term liability of social program beneficiaries.

This involves calculating the potential lifetime liability of every individual on welfare, breaking them down by customer segments/cohorts and targeting interventions accordingly, with annual re-evaluations.

that shows the specific actions needed in particular cases to improve performance and advance agency goals.

### Focus on outcomes, not outputs

#### Social innovation financing: testing new approaches and scaling what works

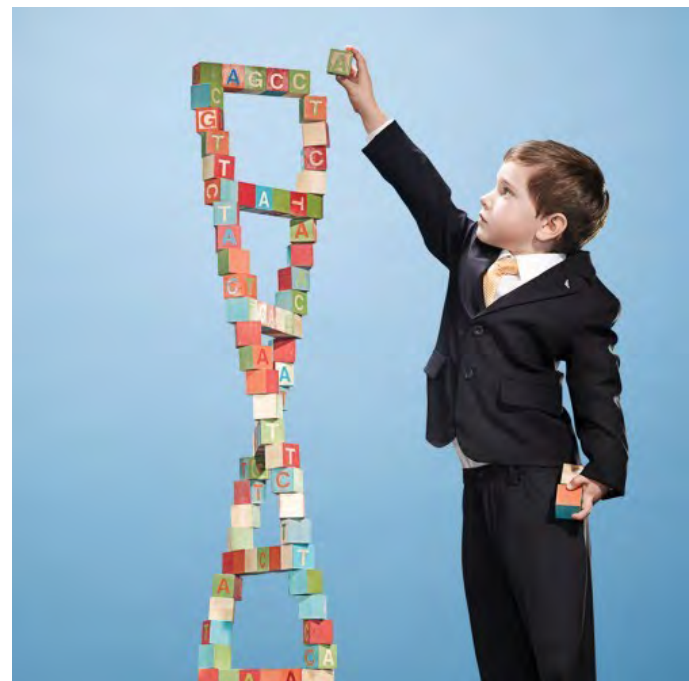
Tight government budgets and growing demands for services drive the growth of social innovation financing, through instruments such as social impact bonds. Through this vehicle, government pays not for legislatively mandated strategies, with their attendant red tape and uncertainty, but for results. The path to the goal is left to the service provider, which shoulders the details and the risks. The bonds guarantee long-term funding, a frequent stumbling block for nonprofits, while the risk is shared among government (which pays for the outcome), investors (who put up money to achieve the outcome) and providers (who deliver the outcome). Focusing on results opens social services to new providers, approaches, business models and investors.

#### Putting the proof before the program

Large public databases and data mining techniques make possible measurements that were once impossible—or too expensive—to pursue. Researchers use administrative data collected for other purposes, such as student test scores, criminal arrest records and healthcare expenditures, to conduct randomized control trials and establish what works. It becomes possible to understand which early interventions make the most difference, and which mix of services under what circumstances help individual clients.

#### Measuring performance to make progress

Building on existing information systems, agencies create dashboards that allow executives to see where their departments stand on each performance measure, and more importantly to monitor their workers' progress toward improving results. Caseworkers use a dashboard



## Law & Justice 2020

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2020 sees law enforcement using innovative new methods and technologies to protect public safety and rehabilitate offenders. Mobile computing and electronic monitoring enable virtual incarceration. Gamified web and mobile interfaces deliver jobs training, connections and rehabilitation services. Data analytics ensure that interventions are tailored to offenders' profiles. As crime becomes more sophisticated, so does policing: drones act as eyes in the sky, while officers on the ground use wearable computing, facial recognition software and predictive video. The fight against cyber-and biocrime shifts from a purely national responsibility to an increasingly important focus for local law enforcement.

### Out-of-the-Box Justice

#### Virtual incarceration

Rapid advancements in geospatial technologies and location-based data analysis converge, replacing countless bars and boxes with state-of-the-art electronic monitoring for low-risk offenders. "Virtual incarceration" combines cutting-edge technologies—wearable and mobile computing, remote check-ins and one-touch access to support services—with cognitive restructuring techniques to achieve the goals of protection, retribution and rehabilitation. The new model has economic implications, as prisons often have served as vital sources of employment in rural areas.

#### Big data for micro-tailored interventions

Justice centers leverage "big data" during pretrial hearings, sentencing and parole hearings to determine the most appropriate candidates for virtual incarceration. These tools help judges select effective combinations of interventions specifically targeted for individual needs and risks. Analytics and predictive modeling—some from novel sources such as facial coding software, which tracks facial expressions to reveal emotions and predict future behavior—reduce the individual and system-level risk of virtually incarcerating offenders.

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#### Winning the "reform" game

Gamified interfaces on web and mobile apps allow offenders to connect and stay engaged with remote training and meetings. Offenders earn points tied to rewards for making check-ins, staying out of high-risk zones and completing pro-social behavioral exercises. Game elements allow offenders to see their progress and break up large goals into smaller, more manageable tasks, making the reform process engaging and achievable. Case managers benefit from dashboards offering features such as interactive maps that allow them to see their charges' movement patterns and behavioral data in real time.

### Justice restored: a dual approach to sentencing

Sentencing increasingly incorporates interactions such as victim-offender mediation, family-group conferences and community restorative boards, which use trained citizens to confront offenders with the consequences of their actions and discuss possible reparations. Benefits include less traumatic stress and related costs for victims and a lower rate of recidivism. Restorative justice programs, enabled by technology, facilitate connections between victims and offenders to create virtuous feedback loops that provide closure and the ability to move on for victims and offenders alike.

### Justice “markets”

Public-private exchanges and full-fledged markets in recidivism reduction and preventative services become ubiquitous, addressing the factors that contribute to criminal behavior (drug dependence, mental health problems, lack of financial and peer support, etc.). Open markets—where buyers include governments, foundations and offender families, and sellers include nonprofits, social enterprises, companies and other governments—are complemented by government-led solutions.

### Next-generation policing

#### Pervasive policing

Real-time intelligence and police demand-matching become so exact and quick that would-be offenders are deterred by a sense of “justice everywhere.”

Analytics such as crime mapping, geospatial prediction, data mining and social network analysis, as well as omnipresent sensor networks and, ultimately, driverless cars that allow officers to operate as data mechanics in a mobile laboratory, coalesce to deliver not just faster response times when crimes occur but the intelligence needed to thwart crimes before they happen.

#### Drone police

Unmanned aerial vehicles and ground-based drones supplement human patrols in almost every stage of policing. During recon, UAVs provide cheaper, more scalable alternatives to police helicopters, gathering and transmitting data in lieu of beat cops. Remote-controlled drones represent the front line in high-risk situations such as stand-offs and bomb threats, saving lives and tens of thousands of taxpayer dollars in manpower and cleanup costs.

Human robocops

Manpower meets computing power. Equipped with an augmented reality app, the camera on a cop’s mobile device becomes as indispensable as a sidearm or handcuffs. Data-overlaid video feeds on handhelds, cruiser windshields and wearable computers such as Google Glass give officers access to real-time language translation, cultural or biometric maps, floor plans and more, as well as instant identification capabilities via facial recognition software. Bolstered by powerful GPS and crowd-tracking capacities, losing a suspect now happens infrequently. Patrol patterns become organic and unpredictable as analytics inside patrol cars route officers to areas of high risk.

### Facial-recognition ID systems

Agents match faces-in-crowd photos and closed-circuit television images against the criminal database. In an instant, agents can identify subjects and their records, and tap real-time data feeds if the subject is serving a virtual incarceration sentence.

### Crime fighting via predictive video

Cities’ closed-circuit television networks, both public and private, become an integral part of proactive crime fighting. While CCTV cameras have been used in subways and streets to identify crime in a retroactive capacity for years, video-analytics software now added to feeds detects peculiar crowd and traffic movements and suspicious vehicles, bags or people, transforming visual data into real-time intelligence.

### Crime prevention officers

As police efforts shift from reacting to crime to stopping it before it occurs, neighborhood police officers are recast as crime prevention officers. As the UK’s Policy Exchange envisions it, these CPOs have much more autonomy than traditional officers and are held directly responsible for crime prevention in their areas. CPOs are equipped with body cameras to collect evidence and protect them from false claims, and meet with commanding officers regularly to review data on their performance. CPOs also play a larger role in the procurement process, testing the latest tools and providing vital feedback before their departments green-light new technology. Creating this new cadre of cops requires a significant change in hiring practices, as CPOs are vetted on the basis of their ability to absorb information quickly and master the newest technologies with ease.

Singapore’s Safe City Test Bed project applies predictive analytics to video feeds to detect which street incidents—crowd and traffic movements—could cause a threat to public safety.

### **Crowdsourced crime prevention**

Real-time crowdsourcing of data on crime (incidence, degree and nature) helps create large databases that can be used to identify areas meriting greater security. Through social media, citizens play a greater role in calling attention to specific issues and identifying and tracking down perpetrators.

The London Metropolitan Police, during the 2011 riots, crowdsourced the identities of 2,880 suspects using a smartphone application. The police asked citizens to download the Face Watch ID app and help identify the persons through images taken from CCTV footage. If an image was known to them, citizens entered the name or address of the person, which was sent to the police immediately and confidentially.

### **Upgrading Cyber Security**

#### **Innovation hubs to fight cyber crime**

By 2020, much of the world's crime is committed through the Internet. Advanced cyber security becomes a necessity—and a huge economic opportunity for innovative problem-solvers and governments willing to collaborate with them. These public-private collaborations look like technology campuses, featuring incubators and “lean” security startups that employ white-hat hackers and emphasize rapid testing and learning, integrating the latest trends into daily police activities.

#### **Interagency security initiatives**

Because of the urgency of the challenge and the need for expertise and economy, different arms of government join forces to fight cybercrime. Governments follow the lead of the Netherlands, which has launched a National Cyber Security Centre, a Centre of Information Security and Privacy and a center for municipal cyber security.

### **Cyber security goes horizontal**

Cyber security adopts cybercrime's networked, decentralized structure as rigid top-down lines between international, national and local jurisdictions dissolve. Security leans heavily on technology, lightweight solutions and international collaboration, characteristics defining a new cadre of global enforcement officers. These GEOs, created at the federal level, can bypass international jurisdictions and seamlessly join foreign teams to bring global cybercriminals to justice.

#### **“Biocrime” demands bio security**

The world sees a spike in a new form of crime, biocrime, as advanced, genetically targeted weapons and DNA-related identity theft insidiously trail the personalized medicine and molecular therapies movement. In response, governments and private genetics companies engage in a global effort to concentrate DNA information in central, secure databases.

#### **Transparency algorithms to identify cyber perpetrators**

One of the biggest challenges of fighting cybercrime is identifying the perpetrator. Police team with academia to build arsenals of algorithms designed to unmask international cybercriminals. From intrusion software to big data correlation, cyber cops now have a range of tools to connect pieces of data with individuals. These algorithms represent some of the core activities at innovation hubs and cybercrime centers. Powerful cloud analytics help agents predict future cybercrime activity. The latter technology requires extensive international cooperation as cloud services and storage providers must agree to participate.

#### **Online national IDs**

As a result of the need for stronger means of online authentication, companies and citizens increasingly rely on government-standardized electronic IDs to interact with all parts of government and commerce. Such identification becomes a de facto requirement for all online services from government, healthcare providers and multinational companies.

## Transportation 2020

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In 2020, transportation is as much about bits and bytes as the physical infrastructure on which we walk, bike, drive, and ride. Sensor-powered dynamic pricing, mobile-enabled collaborative transport models such as ridesharing and social transport apps all help tackle traffic congestion in major urban corridors. Tremendous advances in connected and automated vehicle technology put the first fleets of autonomous or semi-autonomous vehicles on the roadways. Sustainable transport options such as electric vehicles and e-bikes become widespread. Air travel is reimagined through augmented reality-enabled self-service airports, while the skyways see greater drone use for civilian and commercial purposes.

### Digital-Age Transportation

#### Shared transportation models

The convergence of technologies such as mobile communications, cloud computing, geospatial analysis and social media gives rise to shared transportation models. Services such as ridesharing, car sharing and bike sharing help urbanites get around without owning a car.

In 2020, the global car-sharing market is at 26 million members; the North American market leads the way with 15 million members.

#### Real-time traffic management

Real-time information optimizes traffic flows. Traffic data collected through sensors and traffic counters and crowdsourced through commuter GPS and Bluetooth allow for real-time reporting of traffic conditions. Predictive forecasting makes it possible for drivers to choose between the lowest cost and the quickest routes. A smarter, networked transportation system becomes an integral component of city life.

#### “Connected” vehicles

In 2020, many vehicles are connected to one another, the infrastructure around them and various data streams, improving traffic flow and safety. These cars automatically

scan the Web for information about problems ahead or parking spaces at the destination, and suggest alternative routes or even different modes of travel if traffic is too heavy.

#### Automated driving

Driverless vehicles make driving safer, more convenient and more energy-efficient. Building on the pilots and experiments of the previous decade, manufacturers incrementally deploy the first driverless technology on urban roads. Manufacturers incorporate new sensor and GIS technology at the design stage, addressing cyber security issues and thus quelling data privacy concerns. These developments help refine regulations and legislation concerning driverless technology. Consumers can opt to share their data with insurers in return for discounts on insurance payments.

#### Social transport

Transportation systems are built on collaboration among neighbors, communities, governments and traffic managers, touching on everything from traffic planning and signal timing to commute planning. Individual decisions are based on other people’s advice, broader system-level objectives, real-time travel conditions, crowdsourced information and community values. Beyond cost-efficiency, the system provides a social experience by matching personal preferences with transportation offerings.



## Rise of the “Alternatives”

### Pedal power makes a comeback

The market for e-bikes picks up globally, providing an alternative for people who would generally avoid traditional bikes. The battery pack provides an additional boost for bikers on steep inclines or just allows them to move faster. Innovations in e-bike design make bike travel more attractive and affordable. Other designs such as foldable and backpack bikes and ultra-lightweight bikes also power the bicycle revolution.

### Electric vehicles as a feasible alternative

Electric vehicles (EVs) emerge as a workable replacement for gas-powered vehicles. Given limitations on range and the availability of public charging stations, EV growth is fastest in public transport and fleet solutions before retail expansion. The UK is already piloting electric buses on a busy route in London; the buses will be recharged at end of each journey using inductive charging.

## Innovations in Pricing, Funding and Payment

### Dynamic pricing models to improve efficiencies

With pressure building on limited infrastructure assets, new dynamic pricing models improve efficiency and embed two key values in the transportation system: users begin paying a direct portion of the actual cost, and prices respond to demand. The advent of mobile technology and embedded sensors make dynamic pricing possible based on variables such as time of day, road congestion, speed, occupancy and even carbon emissions. Pricing variants include: 1) Dynamic tolling where toll rates change based on variables such as the amount of traffic or time of day; and 2) Dynamic parking which uses sensor technology to provide information on vacant spaces and allows parking managers to adjust pricing according to demand.

SF Park, San Francisco’s smart parking management system uses a network of sensors in 7,000 metered parking spots and 12,250 spots in city garages. If spaces in an area open up, the information is communicated to users within a minute. To manage availability, the application periodically adjusts its pricing according to demand, encouraging drivers to park in underused garages and lots.

### Maturing public-private-partnership transportation models

Governments regularly engage the private sector to help finance and deliver large infrastructure projects using a full complement of public-private partnership (PPP) approaches. These are already commonplace in the UK, Canada and Australia, and by 2020 more markets are reaching maturity. PPP deals go beyond traditional toll user-fee models and include variations such as shadow tolling (with fees based on the number of vehicles using the roadway) and availability payment options (payments based on particular project milestones or performance standards). To increase public acceptance for newly priced roadways, investment PPPs (or IP3s) become common. Under an IP3, public entities divert a portion of the concession payment and toll revenue to a protected investment fund that pays households in the region an annual dividend to help offset the additional costs they incur from tolls. On the finance side, banks and institutional investors embrace a model in which institutions take on parts of the loan based on their risk appetite.

### Beyond the gas tax

Increased fuel efficiency and the popularity of electric and alternative-fuel vehicles continue to erode the gas tax base. To protect the revenue base, governments introduce innovations such as mileage-based user fees (MBUFs), charges based on how much one drives rather than how much gasoline is purchased. Advancements in geospatial and other technologies help mitigate privacy issues.

### Universal travel accounts

Travel cards or smartphones enabled with near-field communication (NFC) provide an integrated payment solution for transportation users. Account-based payment systems integrate all forms of transit payments such as bus fares, metro, parking, tolling, car and bike rentals, etc., reducing transaction costs.

## The Airport Re-imagined

### Augmented airports

The Copenhagen airport is already piloting an app to help passengers find their way within the airport. By 2020, a common 3D tool on a mobile or wearable augmented reality device positions passengers through the triangulation of Wi-Fi access points in the terminal, and guides them through each section of the airport.

### Total air travel mobile apps

With advances in mobile and NFC technologies, all travel-related information moves to electronic formats. A master mobile app provides end-to-end service, aggregating research and booking for airlines, airports, hotels and ground transport; at the airport, it guides commuters through the terminal and tells them where to check in, check luggage and exchange currency.

### Self-service airport

The self-service airport takes travel convenience a step further, offering an automated system integrated from departure through arrival, including self-help check-in kiosks, e-passports and facial recognition for immigration formalities and mobile-enabled e-boarding passes.

### Civilian drones enter the skies

Unmanned aerial vehicles appear in an ever-increasing variety of commercial and civilian roles, including geological surveys, law enforcement, environmental monitoring, asset management and emergency response. Civilian UAV markets develop in countries with drone-friendly regulations.

By 2017 total air travel passenger numbers rise to 3.91 billion—an increase of 930 million passengers over the 2.98 billion carried in 2012.





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