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A report from the
Deloitte Center for Integrated Research

Teach the world, feed the world, save the world: Use cases for social good

Advancing the social impact agenda with next-generation cloud, broadband, and 5G infrastructure

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Technology for social impact

SOCIAL IMPACT IS an increasingly important business measure as companies look to become social enterprises.[1] Organizations have a unique opportunity to use ***technology for social impact*** when adopting strategies that create social and business value—be it the ability to expand access to education, enhance food production, or create safer and more equitable cities and communities. While it may apply tremendous pressure on businesses and engineers to meet these social expectations, technologies like the cloud could help with the challenge. Innovative new infrastructure combinations[2] that combine 5G, the edge, satellites, and other technologies with the cloud are coming together for transformative potential. In fact, in one of Deloitte's recent surveys, more than 80% of executives surveyed said advanced connectivity is important to capitalize on advanced technologies (artificial intelligence or AI, edge computing, and data analytics).[3] The question is, how to unlock the technology's potential?

Making an impact: Teach the world, feed the world, save the world

When combined with other new and emerging technologies, cloud could arguably help social enterprises with several government, business, and social challenges (figure 1).

Addressing these pressing social challenges requires architects[4] to **innovate in the real world** in areas such as **virtual learning and work, precision agriculture, and transportation mobility** where the stakes are high and the need is real.

- **Virtual learning, digital education, and remote work**—5G/4G/LTE mobile hot spots and improved broadband access plus cloud could help improve bandwidth and quickly power software and services.
- **Precision agriculture**—5G plus cloud, the edge, satellites, and other technologies could unlock real-time data streaming and power intelligent edge/cloud computing networks.
- **Transportation and urban mobility**—5G plus cloud and edge computing could transmit and compute data at high speeds to advance the future of autonomous vehicles and support connected transportation infrastructures, such as those used for waste management and carbon-emissions reduction.

FIGURE 1

Cloud for social impact technical attributes and potential business cases

TECHNICAL ATTRIBUTE	NETWORK REQUIREMENTS	COMPUTING REQUIREMENTS	POTENTIAL USE CASE
Network connectivity and application access	• Expanding connectivity access to rural areas • Providing high-definition video access for live streaming	• Providing SaaS access to collaboration and business tools • Providing data storage and flexible, scalable cloud-enabled infrastructure	• Virtual learning/education • Remote work • Next-generation microfinance • Rural health care access[a]
Distributed computing	• Making data accessible from previously unconnected areas • Expanding real-time data streaming bandwidth across IoT devices	• Capturing/storing more data for predictive analytics • Managing real-time computing from the edge to the cloud for advanced analysis and access to cloud services (IoT, machine learning, etc.)	• Enhanced precision agriculture • Smart factories • Safer nuclear power plants • Greener shipping and supply chains
High speed/high throughput/ low latency	• Streaming data	• High-speed computing with AI and IoT services	• Remote work • Public safety • Disaster management • Greener mobility infrastructure (smart traffic lights/vehicles) • Streaming "gaming" simulations for peacekeeping or combat

Note: [a] Alex Schulte, Melissa Majerol, and Jessica Nadler, "Narrowing the rural-urban health divide," Deloitte Insights, November 27, 2019.
Source: Deloitte analysis.

Instant infrastructure access: Teach the world

BEFORE THE GLOBAL pandemic, organizations were reimagining digital education. Analysts expected the e-learning market to grow from US$200 billion in 2019 to US$375 billion in 2026.[5] Learning institutions were exploring digital education and ed-tech strategies that connected parents, teachers, peers, administrators, and mentors with the student across integrated, personalized, and continuous learning experiences.[6] Universities were embracing digital platforms for hybrid-learning models combining on-campus and online learning to drive skills, mentorship, and intern opportunities.[7] In adolescent and secondary education (K-12), institutions had embraced digital solutions to create smart classrooms and parental-engagement apps for the youngest students, but not digital and remote learning.

The pandemic changed all of that. People across the globe were forced to embrace virtual learning almost instantaneously *and* at scale. Beyond the technical challenges, this change—inflection point, really—highlighted existing inequities related to high-speed internet access and collaboration tools. Both are *essential* for K-12 virtual learning, *an enabler* for diverse and personalized digital learning strategies across higher education, and a *lifeline* to remote work for recent graduates.

In response to the pandemic and its effects, the government passed the Coronavirus Aid, Relief, and Economic Security Act (CARES Act), which included roughly US$30 billion in education relief for states, K-12 schools, and higher-education institutions (including student grants).[8] Telecommunications and technology providers donated money, discounted mobile hot spots, enabled cloud video solutions, and provided physical devices to students[9] to support distance-learning and to standardize digital classrooms.[10]

Organizations with existing cloud-based platforms had an advantage when ramping up remote learning.[11] By combining the cloud with wireless and wireline solutions, education institutions can better expand K-12 access to the roughly 3 million US students without a home internet connection[12]

Universities were embracing digital platforms for hybrid-learning models combining on-campus and online learning to drive skills, mentorship, and intern opportunities.

and the 16.9 million children who lack high-speed home internet to support online learning[13] (figure 2).

The long-term stakes are high if children are left behind. Early research related to remote learning during the pandemic shows disenfranchisement comes at a tremendous cost—a third of math progress can be lost, and low-income students are disproportionately affected.[14]

Ultimately, cloud and other network technologies can unlock internet access and allow for the instant access to software and services needed to *teach the world,* and:

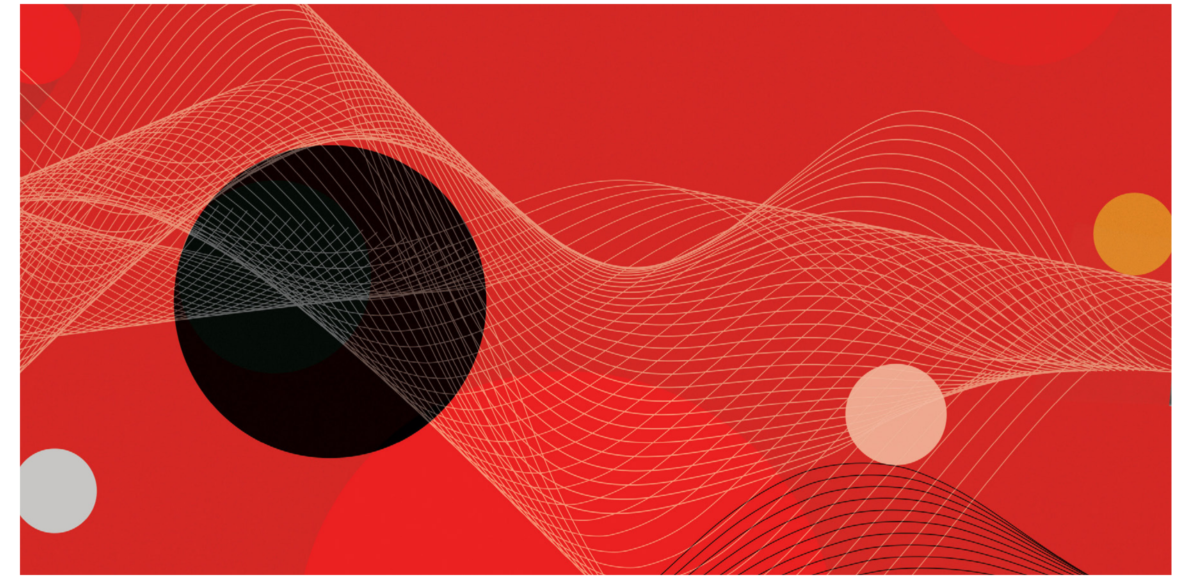
- **Transform learning**—allowing students to gain improved virtual learning access, to create more standardized and repeatable educational experiences and to tailor personalized coursework

FIGURE 2

Instant access to virtual learning and digital education

USE CASE	EXISTING CHALLENGE	TECHNOLOGY POTENTIAL	POSSIBLE BENEFITS
Learning organizations need to unlock internet access for students in remote areas.	Students have unequal access to education in rural communities where network, hardware, and software are absent. Slow organizational rollout of remote learning systems that integrate content, collaboration, and tracking has made remote learning strategies a challenge to roll out at scale.	Learning organizations can work with communications service providers to expand network access, speed, and reliability with wireless and wireline connectivity. Contracting with cloud vendors and embracing cloud solutions allows learning organizations to offer standardized tech architectures (whether through the same software or not) at a lower cost barrier to entry (e.g., mobile devices) leveling the playing field.	• Equal access to education for students across communities leading to higher graduation rates, test scores, etc. • Improved virtual learning opportunities and experiences • More standardized, repeatable, automated, and personalized learning • Improved access to postgraduation remote work opportunities • Improved coordination for parents/teachers at K-12 levels where remote learning can be challenging • Faster rollout of digital education strategies for public and private higher education institutions

Source: Deloitte analysis.



- **Deepen engagement**—allowing learning institutions to create automated processes that track and increase student engagement and involve parents
- **Innovate education**—creating a digital education foundation on which to build in new experiences, such as gamified learning through videos and virtual reality

EXPANDING THE OPERATING MODEL BEYOND TECHNOLOGY

There is no easy answer to rethinking the student, educational institution, and technology relationship. As described in *The future(s) of public higher education*,[15] there are five potential models that can be considered for the future of public higher education. These are the Entrepreneurial University, Sharing University, Experiential University, Subscription University, and Partner University. These models can contribute to a vibrant, innovative, and efficient public higher education system.

Distributed computing: Feed the world

WHEN SPEAKING OF Land O'Lakes' 150 million acres of productive cropland, Beth Ford, president and CEO, said, "... unreliable or nonexistent high-speed internet in rural areas keeps these [data-based, precision agriculture] tools out of reach for many ... we will work to address this need and help farmers remain profitable and sustainable."[16]

This sets the stage for smart agriculture tools. Smart agriculture was a US$11.45 billion business in 2018 and is expected to expand to US$30 billion by 2027 with increased focus on livestock monitoring, disease recognition, farm resource consumption, efficiency, and productivity.[17] Agricultural robots make up US$6.5 billion of that industry and are driving innovation in field

FIGURE 3

Distributed computing to advance precision agriculture

USE CASE	EXISTING CHALLENGE	TECHNOLOGY POTENTIAL	POSSIBLE BENEFITS
Government and commercial organizations are looking to facilitate smart agriculture and optimize food sources and water supply.	Agribusinesses are facing a growing set of challenges related to climate change and population growth, resulting in pressure on the global food production and growing demand for clean resource management. Bandwidth deserts create data holes where important information cannot be captured across rural farms or relayed to back-end cloud systems. 4G plus IoT/edge infrastructures require organizations to be selective about what data to collect and analyze.	Radio-fitted devices deployed in the field can send more data to a back-end cloud system for analysis. The cloud allows organizations to process more data and employ integrated machine learning and IoT services to take advantage of the spatial web.	• Better control of groundwater by regulating its availability/use in climate-related drought conditions and natural extraction • Improved visibility into the health of the land/animals for more strategic planting and harvesting • Increased food production (crops, milk, eggs, etc.) • Better understanding of fuel usage, productivity levels, and business performance

Source: Deloitte analysis.

mapping, aerial data collection, planting and seeding operations, and more.[18] The rise in the use of satellite data, agricultural IoT,[19] and edge computing is giving technology a life-or-death role to play in agriculture. These tools are being used for monitoring and optimizing food sources and water supply, given rising populations and the risk of climate change.[20]

The US government has set up a US$9 billion fund for rural 5G coverage. Of this, at least US$1 billion is expected to be reserved for 5G to quickly collect and process satellite data to support precision agriculture[21] with a focus on making farmland output more bountiful and profitable,[22] and enabling "smart farming" that has the potential to create more than US$10 billion in business value in the United States alone.[23]

Taking it to the next level, by teaming cloud-native 5G networks and edge solutions with cloud storage and computing, enterprises can advance to more distributed computing. As a result, farmers can move from using reactive networks able to analyze limited data to intelligent edge computing across IoT and artificial intelligence services as well as back-end data analytics.[24]

Ultimately, cloud, IoT, edge, satellites, drones, wireless, and wireline technologies can come together to enable more data processing across the network, allowing farming organizations to:

- **Increase crop production:** Farmers can use drones for landscape and insect imaging. They can use cloud-enabled analysis to identify pests and then perform precision crop-dusting strikes to deliver the right chemical mix to kill insects but leave the crops unharmed. This can help early mitigation of plant stress and optimized seeding, fertilizing, growing, harvesting, distribution, and lower farm carbon footprint.[25]
- **Preserve water to manage scarcity:** By analyzing weather, drone, satellite, and other data to understand the moisture level of the soil, and adjusting watering, farmers can apply the right amount of water to individual zones and save 15% of the water on average.[26]
- **Improve the downstream supply chain:** In the United States, farms contribute more than US$130 billion to the economy.[27] However, between 30% and 40%—equating to US$161 billion—of food produced is wasted *every year*. Cloud-enabled big farming has the potential to reduce waste and improve margins across the supply chain from the farm to the store and then to the table. Several startups are looking at analytics for retailers to manage ordering based on past consumption and adjusting it based on dramatic changes to product consumption due to the global pandemic.[28]

READINGS TO CONSIDER RELATED TO THE BUSINESS CASE

For additional resources on precision agriculture strategies and technologies, see:

- Joe Mariani and Junko Kaji, "From dirt to data: The second green revolution and the Internet of Things," *Deloitte Review* 18, January 25, 2016.
- Chris Arkenberg et al., *Unbundling the cloud with the intelligent edge: How edge computing, AI, and advanced connectivity are enabling enterprises to become more responsive to a fast-moving world*, Deloitte Insights, September 8, 2020.

High speed/high throughput/ low latency: Save the world

PERHAPS ONE OF the most exciting, yet illusive, social impact technology use cases is the autonomous vehicle that could save thousands of lives[29] by using location, health, vehicle, weather, similar data, 5G, the edge, and the cloud to create safer and smarter experiences. Yes, the long-term potential is exciting. The short-term promise, however, is limited, and technology strategies for social good could be better served by focusing on mobility infrastructure more broadly. Deloitte's Future of Mobility research has estimated that data traffic associated with mobility and transportation could grow to 9.4 exabytes every month by 2030,[30] likely making the cloud a critical component to manage this type of infrastructure.

Urban mobility and transportation infrastructure powered by a network of the cloud, IoT, the edge, and wireless/wireline technologies can help across safety, emissions, congestion, convenience, access, and equity.[31] To begin to imagine the potential for carbon reduction, for example, look at what just one US city was able to accomplish by implementing "smart" traffic signals. Not only did commuter travel time reduce, but the vehicle idle time dropped by more than one-third.[32] The reduced idle time is significant, given that the transportation industry is the greatest contributor to carbon emissions at 28% with light-duty vehicles (59%) and medium- and heavy-duty trucks (23%) as the biggest contributors.[33] Another city implemented a cloud-based command center to analyze data and insights across mobility, construction waste, and public safety across city resources used by 1.2 million tourists annually. It reduced energy cost by 20% and operational costs by 40%. Additionally, it saved 900,000 euros (roughly US$1 million) annually for waste management and 10%–27% in terms of mobility through an electrical vehicle-charging network across bikes, kiosks, buses, etc.[34]

These technologies have the potential to take mobility initiatives related to sustainability and public safety to the next level. Imagine being able to:

- Create a virtual twin for a city to measure and manage adverse environmental impacts before they happen
- Simulate real-time "gaming" scenarios to advance peacekeeping initiatives
- Run risk scenarios related to catastrophic events, including everything from a major oil spill to a nuclear reactor malfunction
- Create safer and greener traffic management systems with connected wearables, cars, and surrounding infrastructures that save lives and reduce carbon emissions

The short-term promise, however, is limited and technology strategies for social good could be better served by focusing on mobility infrastructure more broadly.

Making an impact: The cloud-carbon equation

IN DECIDING TECHNOLOGY-FOR-SOCIAL-IMPACT strategies that tap into the cloud, one consideration should be the cloud's carbon footprint. Data centers are massive consumers of electricity—thought to currently account for 2% of total global consumption with the potential to rise to 8% by 2030.[35] The technology, media, and telecom sector is facing pressure on energy efficiency and sustainability; 72% of organizations are starting to feel the pressure to demonstrate how their energy-management measures address climate-related risks, and 74% have raised their reduction targets.[36]

When moving to the cloud, aim for a zero-sum game that reduces the organization's existing data center footprint. Shared cloud hardware can achieve 80%–90% improvement in energy consumption,[37] raising 5%–15% hardware utilization in a physical data center to up to 80%–100% utilization in the cloud.[38] This is possible when all of the hyperscalers are investing in their carbon neutral/negative strategies related to their cloud-enabled data centers and computing infrastructure. These strategies include a focus on data center energy efficiency, clean energy credits, use of recycled plastics, and more.[39] For example, one cloud provider was able to reduce energy use by 40% (15% overall energy use) by using artificial intelligence to predict computational load and better manage data center cooling and performance optimization.[40]

When moving to the cloud, aim for a zero-sum game that reduces the organization's existing data center footprint.

The 5G/cloud potential: Beyond broadband

5G BRINGS WITH it the promise of peak data speed, ultra low-latency, improved reliability, greater network capacity, high-definition mobile video streaming, distributed information networks, and more.[41] When combined with cloud, edge, and other technologies, it can provide distinct opportunities to tap into a powerful infrastructure for social good. At the heart of many of these challenges is reliable wireline and wireless internet **access** that is hampering, for example, the nearly 11 million people (approximately 3.3% of the US population) who live in rural and "less urban" areas[42] in **broadband dead zones**.[43] These pressing social challenges require architects[44] to **innovate in the real world** in areas like **virtual learning and work, precision agriculture, and mobility**. To manage the access challenge, the US government has had several initiatives focused on rural broadband and wireless connectivity including a US$9 billion 5G fund for rural connectivity,[45] a US$137 million investment to bring high-speed internet to homes and businesses over the next decade,[46] and a $20 billion Rural Digital Opportunity Fund. Nonetheless, new technology innovations provide a range of opportunities to find the right solution for a given scenario.

The 5G and cloud combination in particular is an exciting one for its ability to deliver:

- **Instant access**—broader connectivity optionality for network access and dynamic, spectrum sharing on low bandwidth or via mmWave to power cloud applications.

- **Distributed data**—infrastructure that takes advantage of unfettered real-time data streaming powered by 5G, edge, and cloud technologies that increases the ability to offload data from endpoint devices (IoT, etc.) to the cloud for greater computing power and the spatial web's[47] promise.

- **High speed/high throughput**—faster data streaming and faster computing power enabling advanced ultra low-latency use cases.

Looking ahead

As organizations look *ahead* to new, sustainable growth opportunities; *inside* to reconfigure and transform their operations; and *around* to leverage their business ecosystem,[48] they should consider measuring the business value of the social impact.[49] With cloud strategies, that starts with creating the business case, continues on to defining the technology strategy, and ends, hopefully, with a more sustainable business and world.

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