DELL Technologies

WHITE PAPER

REALIZING 2030: THE NEW ERA OF HUMAN-MACHINE PARTNERSHIPS

A Public Policy Roadmap for Governments

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2030: A NEW ERA

Family robots, caregiving robots, and civic robots will become commonplace as deep learning improves robots' abilities to empathize and reason. Mixed reality technologies will enable people to apply multiple senses to experience media through embodied cognition, creating new opportunities to improve education, health care, travel and transportation, construction, and manufacturing – and help promote new, more diverse workforces by reducing unconscious biases.

Artificial intelligence and machine learning will help us work more efficiently and with greater speed and accuracy, finding and deploying resources rapidly to wherever they are needed, whenever they are needed.

"Experts estimate that 85% of the jobs that today's learners will be doing in 2030 haven't even been invented yet."

And entirely new industries and jobs will surface. Experts estimate that 85% of the jobs that today's learners will be doing in 2030 haven't even been invented yet. This is the vision of the future in 2030 from an Institute for the Future (IFTF) report, commissioned by Dell Technologies – a vision we are hard at work preparing for today.[1]

DEEPER HUMAN-MACHINE PARTNERSHIPS

From hand axes to trebuchets and weaving looms to mobile devices, people have lived and worked with machines for centuries. Society is now about to enter a new phase, characterized by even greater efficiency and possibility than ever before. Robotics and automation, artificial intelligence (AI) and machine learning (ML), virtual and augmented reality (VR and AR), and cloud computing, each enabled by significant advances in software, have the potential to solve some of the intractable problems that long have faced humanity.

By framing the relationship between humans and machines as a partnership – without giving in to anxiety or euphoria - we can responsibly begin to build capacity in machines to improve their understanding of humans, organizations and society as a whole. This will allow us to be better prepared to engage meaningfully with emerging technologies.

1 IFTF-Dell Technologies report, The Next Era of Human-Machine Partnerships: Emerging Technologies' Impact on Society & Work in 2030

DELL TECHNOLOGIES' ROLE

With our mission to create technologies that drive human progress, we envision a world where technology helps cure cancers, provides safer and more efficient transport, improves agricultural and manufacturing production, offers interesting new jobs, and greatly improves the quality of life. As we work to develop these empowering new technologies, we are mindful of both the opportunities and responsibilities that come with such powerful tools. To prepare for this new world, we've outlined our forecasts for 2030 and how governments can responsibly achieve prosperity and success in 2030. This Realizing 2030 Policy Roadmap draws on our insights and experience as a global leader in applying emerging technology solutions to improve lives – and insights from the 3,800 business leaders from around the world who Vanson Bourne surveyed to gauge their predictions and preparedness for the future[2].

2 Vanson Bourne-Dell Technologies report, Realizing 2030: A Divided Vision of the Future

POLICY ROADMAP TO REALIZING 2030

For global governments to leverage emerging technologies to reach prosperity, accomplish the United Nations Sustainable Development Goals and, ultimately realize 2030, they should focus on four key public policy areas: trust, innovation, workforce readiness, and sustainable development. Nations should deepen their investments in emerging technologies, adopt a policy and regulatory framework that ensures consumer trust as well as facilitates innovation and investment, and enable swift and cross-sectoral adoption of new technologies.

Governments should also encourage leaders across all sectors to collaboratively resolve challenges across health and education, future of work, manufacturing, and urbanization through innovative solutions.

Policy Recommendations

To realize the promise of these emerging technologies and the new human-machine partnerships by 2030, governments should enact public policies that:

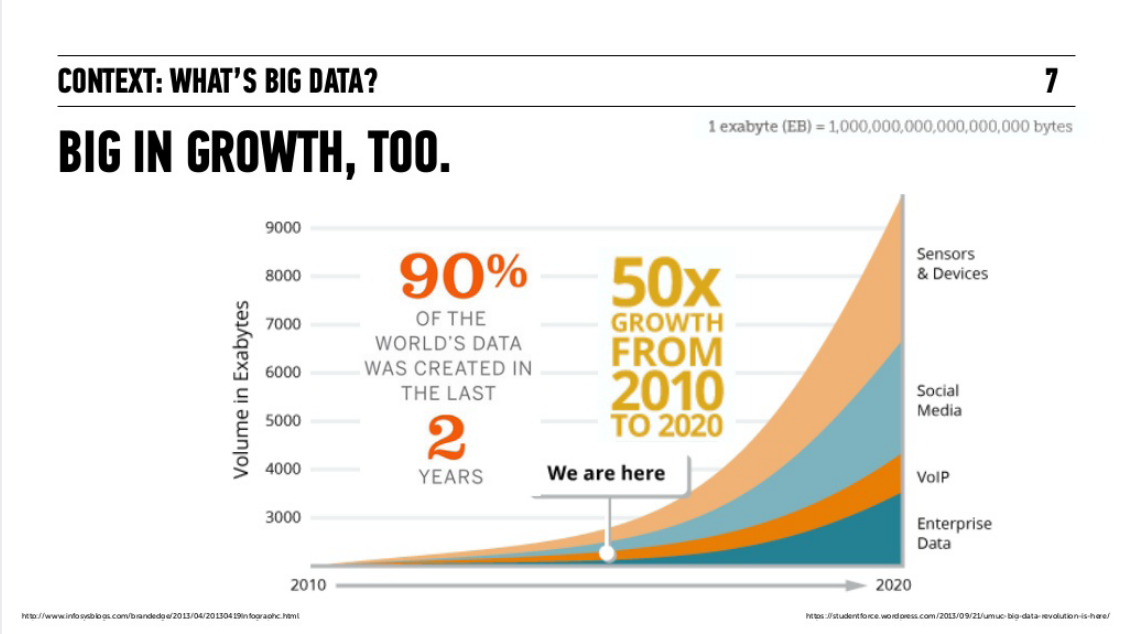
- Preserve trust in the technology that drives advancements.
- Foster innovation by supporting entrepreneurship, the data economy, and open markets for the global flow of goods, services and data.
- Support workforce readiness by using emerging technology in schools and businesses for personalized learning, remote learning, hiring and on-the-gig, in-the-moment training.
- Promote sustainable development through smart city and sustainability initiatives.

Trust

As we move from a compute-centric to a data-driven world, commercial success and the public good increasingly depend on the ability to collect, process and analyze large amounts of data from various sources. For governments and businesses to realize the benefits of new technologies, society must trust that the data collected is private and secure – and is being responsibly used. However, our survey of business leaders found that many have concerns about the impact of emerging technologies – with concerns about privacy infringement, inability of technology to decipher between good and bad commands, and a call for clear lines of responsibility and protocols in the event autonomous machines fail. Recognizing that recent actions and inactions by technology companies and organizations using technology have not lived up to the public's expectations of responsibility, these organizations must work together to restore the public's trust in their operations.

Cybersecurity

The need for cybersecurity in an increasingly connected world is clear – from individuals to smart cities, from mobile phones to cloud computing. As technology becomes more intimately involved in our daily lives, our dependence upon them increases. In the future, even a temporary loss of technology may not only cause a loss in productivity but also a psychological impact on our lives. Nearly half of our surveyed business leaders worry that the more they rely on machines, the more they will lose in the event of a cyber-attack. The subversion or corruption of our technology could result in disastrous harm to our lives and businesses if, for example, medical treatment devices deliver the wrong medication or home and work automation cause us injury and/or damage our products and businesses. And yet fewer than half of our surveyed business leaders believe they have a digitally savvy workforce or effective cybersecurity defenses in place.



To protect against future threats, cybersecurity frameworks and workforce competencies will need to dramatically increase over the next decade. The process has already started, as more and more organizations are developing a cybersecurity culture amongst their workforce and portfolio, with education on the latest threat vectors and implementation of new policies and practices to neutralize these threats. Frameworks and cultures that ensure a secure infrastructure, integrate with the ecosystem, and practice cyber hygiene (so everything in the system is protected – down to individual bits of data) will allow organizations to step forward with confidence as they embrace the technological landscape of 2030.

Policy Recommendations: Trust

Governments should adopt appropriate data safeguard policies to address these privacy and security concerns while providing legal certainty for businesses, by:

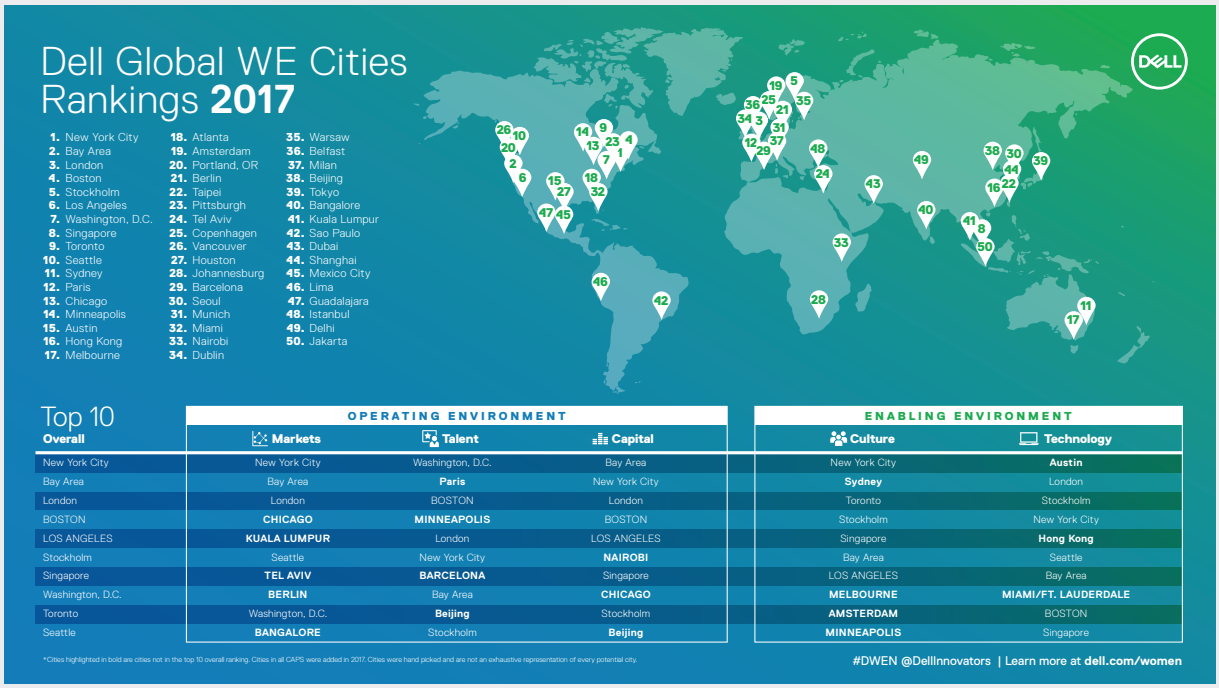
- Promoting data privacy and cybersecurity, via voluntary conformance with open, global standards.
- Encouraging developers to adopt privacy-by-design approaches in their technology solutions.
- Resolving conflicts of law or jurisdiction caused by different approaches to cybersecurity and data privacy, using standardized agreements among governments.
- Implementing smart, open data platforms to share their own government data, with privacy safeguards, to foster innovative solutions to societal problems.
- Encourage R&D in technologies such as blockchain and quantum computing that could offer new security options.
- Incorporating global standards into procurement policies to ensure respect for justice, transparency and sustainable practices across operations and supply chains.

To protect its confidential student data and 5,000 computers across 34 schools, Pembina Trails School District uses Dell Encryption Enterprise for comprehensive, centrally managed endpoint encryption capabilities. This service helps the schools meet strong privacy protection standards and more effectively manage their IT system.

Dell.to/PembinaTrails

Innovation

We live in a global economy where global trade provides new opportunities for expanding markets and collaboration. Open markets foster innovation and domestic investment increases where customers have access to these markets. The most innovative economies are those that promote open labor and product markets, cultivate an entrepreneurial culture and foster the creation of new businesses, adopt fair and transparent tax policies, and ensure open internet access. Emerging technologies like AI and machine learning that analyze increasingly large sets of data will be more effective /and create more innovation opportunities if they can utilize data across government boundaries.



In this global economy we also rely on intricate worldwide supply chains and logistical support to reach new customers around the globe, with the help of a diverse workforce. Unrestricted trade is essential for continued economic growth and job creation – and emerging technologies like AI and blockchain can help further boost innovation, efficiencies and security in product development, manufacturing and logistics. People and organizations will benefit as trade and investment spread new ideas and innovations.

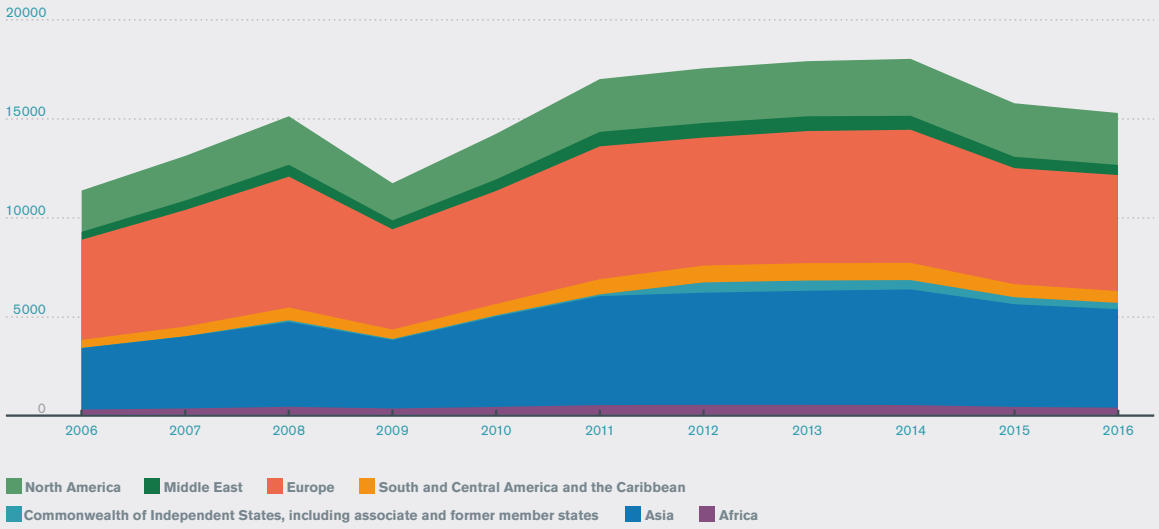
In a groundbreaking project, Dell, Pivotal and Circular Board partnered to develop an artificial intelligence business platform, Alice. Pushing new frontiers in human machine partnerships, Alice connects women entrepreneurs in real time with mentors, resources and events that help scale their businesses, constantly improving via machine learning.

Dell.to/HelloAlice

Open labor and product markets, fair and transparent tax policies, and open internet access make economies more attractive destinations for investors – while tariffs and trade barriers only serve to impede innovation, economic growth, and job creation. As emerging technologies accelerate the pace of change in product innovation, market disruption, and creation of new market leaders, countries that welcome information sharing, research and development, and cross-border data flows will become the leaders in creating greater prosperity opportunities for their people.

Merchandise trade of WTO members has increased to US$ 15.4 trillion, up from US$ 11.7 trillion in 2006.

World merchandise trade of WTO members, 2006-2016 (US$ billion)



Note: World trade is calculated as an average of exports and imports of merchandise trade.

World Trade Statistical Review 2017, World Trade Organization,
https://www.wto.org/english/res_e/statis_e/wts2017_e/wts17_toc_e.htm.

Policy Recommendations: Innovation

One of the foundational elements of an innovative culture is a workforce educated in science, technology, engineering and mathematics (STEM), digital literacy, and entrepreneurship – in both public education and other training programs. In addition, governments can foster an environment for businesses to create jobs, entrepreneurs to thrive, and for a data-driven economy to realize its full potential, by:

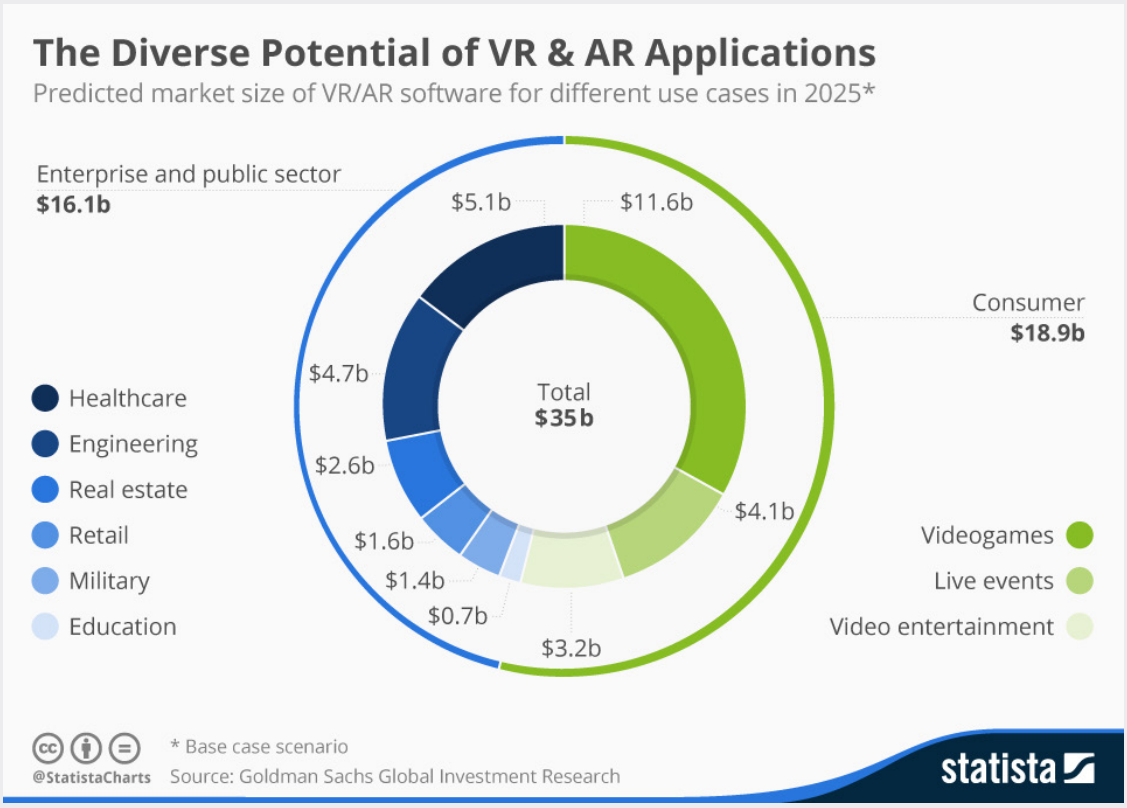
- Improving entrepreneurs' access to capital, with incentives to invest in startups and support infrastructure to reduce scale-up costs.
- Facilitating technology access and strengthening the technology infrastructure to increase access to global markets and opportunities to scale business, including by promoting high-speed broadband, particularly in rural areas, and allocating wireless telecom spectrum for mobile services.

- Providing a favorable regulatory and procurement framework to foster new competition and disruptive business models driven by emerging technologies.
- Implementing state-of-the art e-government solutions and opening up government data to provide better and more transparent public services, reduce red tape, and enable new data-driven applications.
- Transferring more government IT operations to clouds to perform real-time data analytics to understand key business challenges and manage supply chain uncertainty.
- Investing in basic and applied research in emerging technologies, and offering incentives to encourage the private sector to also invest in R&D.
- Helping businesses gain access to global markets by promoting global, open standards for reliable cross-border data transfers, business support services and networks.
- Empowering businesses to start, grow and innovate by supporting diverse workforces and fostering mobility for highly skilled workers.
- Supporting free and open trade policy to open new markets for businesses of all sizes, while addressing investment safeguards, transparency, and due process in government procurement and intellectual property protection and enforcement, and opposing tariffs and trade barriers, which ultimately restrict economic growth and innovation.
- Adopting competitive, fair and transparent tax policies that encourage businesses to invest in innovation, infrastructure and training

Workforce Readiness

The IFTF futurists predicted that 85% of the jobs we will be doing in 2030 have yet to be invented– and by 2030 the entire process of finding work will be flipped on its head. Schools need to prepare for this new paradigm, businesses need to carefully manage these significant shifts, and students and workers need to be prepared. Of our surveyed business leaders, more than half expect that new learning resources (e.g., online, peer-to-peer, bootcamps, MOOCs) will replace university learning for many students; more than half believe schools will need to focus on teaching how to learn rather than what to learn; more than half predict the future workforce will absorb and manage information in completely different ways than today; and nearly half expect more businesses will work with schools and universities to train-up the next generation.

The 2030 workforce also will face the challenges from being comprised of four different generations. Each generation has grown-up with varying degrees of technology usage. As machine interactions become more central to the day-to-day function of work, 87% of business leader surveyed say they expect to struggle to offer equal opportunities across different generations of workers due to varied digital skill sets and mindsets. And our survey suggests that the workforce is evenly split over whether the future represents an opportunity or a risk, whether they'll be more productive by collaborating more or working independently, and whether they'll have more job satisfaction by offloading the tasks that we don't want to do to intelligent machines. To succeed in the next era, organizations will need to bring different cohorts of workers up to par, by keeping their workforce engaged, excited and open to new possibilities.



In this changing economic and technological landscape, governments can promote innovation and investment, and empower people to harness these emerging technologies for good. Proactive investments in the technologies that will define the 21st century – cloud computing, AI, ML, VR/AR, robotics and automation – will sharpen nations' economic and digital edge and will strengthen their competitiveness. To thrive in the new world of 2030, governments need to adjust to the world's changing realities and empower people of all backgrounds with critical technical, training, and adaptation tools. Governments, communities and businesses need to share best practices, develop hubs of technology expertise and innovation, and accelerate deployment of new technologies across a range of sectors.

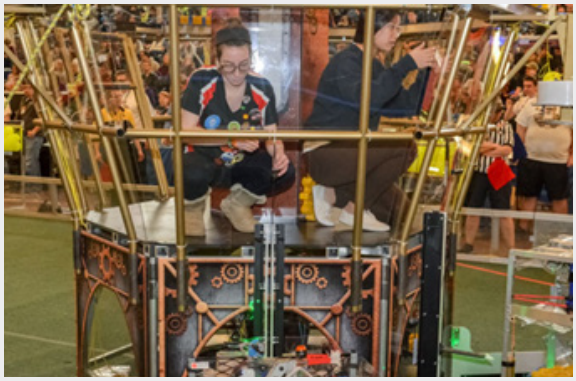
According to our surveyed business leaders, students and workers will need the following skills and traits to thrive in 2030:

- Creative drive
- Logic
- Emotional intelligence
- Technology literacy – easily integrate emerging technologies into work and life, can code
- Judgement and complex decision-making

Educators, parents and students will face increased urgency in recognizing the importance of working with and understanding emerging technologies. More and more, society and the workforce will no longer reward the mere possession of knowledge but instead will reward the ability to continually seek and effectively apply new knowledge and skills in ever-changing settings.

Youth learning is one of the major focal points of Dell's Legacy of Good. We have long supported such K-12 STEM education efforts as FIRST Robotics and the Vex Robotics Competition. Students learn not only engineering skills but also problem solving, time management, conflict resolution, communication and collaboration – all skills critical for the new workplace.

Dell.to/Robotics



Individuals' skills and competencies will become searchable through reputation engines, data visualization, and smart analytics, which will allow organizations to pursue the best talent for discrete work tasks anywhere in the world. VR/ AR technology will increase managers' ability to evaluate a worker's aptitude for learning and applying new knowledge – and help reduce biases and stereotypes in job hunts by showcasing skills without revealing gender or ethnicity. By loosening the ties between work and geography, it will be possible to chip away at the misalignment of global talent that exists today – particularly boosting emerging regions like South-Central Asia and Sub-Saharan Africa – and allow more individuals to learn, communicate and collaborate across institutions and time zones.

Dell is helping Interplay Learning become a leader in VR and 3D simulation training and testing software for the skilled and industrial trades. Interplay believes that people soon will seamlessly move between realities to apply the skills they learn in the real world and will use an AI virtual mentor to assist their learning.

Dell.to/InterplayVR

Emerging technologies will reshape the methods and tools available to impart information, requiring workers to have both access to such technology and the confidence to use it. Workers will partner with machines to learn while on-the-job, and in-the-moment learning will become the modus operandi by 2030. Nearly half of our surveyed business leaders expect their workers will use VR/AR headsets to train for new situations, to receive and act on real-time data, and to "wait-learn" during down time. The ability to gain new knowledge will be valued higher than the knowledge people already have – making the ability to learn, collaborate, communicate, and innovate even more important.

Policy Recommendations: Workforce Readiness

To strengthen our students, education systems, workers, and businesses for the significant transformations we expect by 2030, governments can best assist by:

- Emphasizing STEM, critical thinking, emotional intelligence, communication, and digital literacy in public education and training programs.
- Fostering in schools a culture of innovation, "tinkering," collaboration, and entrepreneurship among students and teachers.
- Adopting innovative technologies and online platforms that can make education more affordable, accessible, and effective – and improve access to top-ranking educators.
- Leveraging data analytics to provide personalized learning and VR/AR technology to enhance classroom and remote learning with immersive content delivery.
- Ensuring schools have access to high-speed internet and emerging technologies.
- Fostering partnerships between schools and the private sector to provide students with mentoring, career guidance, and apprenticeship programs.
- Encouraging companies to partner with universities to align curricula with rapidly changing industry needs and expectations.
- Encouraging private companies and educational institutions to implement ongoing skilling and re-training programs as jobs and needs change, including in-the-moment / on-the-job learning.
- Promoting contextualized intelligence, entrepreneurial mindsets, and automation literacy among people of all ages.

Sustainable Development

Emerging technologies can help communities not only grow their economies but also tackle larger social and environmental issues. These technologies will provide nations with critical tools to help achieve greater global prosperity through meeting their own goals and the United Nations Sustainable Development Goals (SDGs). Technology offers bold new opportunities – for countries and communities ready to harness their innovative and entrepreneurial spirit – to improve access to higher-quality education, expand the capability and reach of healthcare providers, empower workers with new skills, drive more inclusive growth and development, and foster the innovation needed to tackle other concerns.

One aspect of sustainable development that emerging technologies can assist with is environmental sustainability. We see incredible opportunity to utilize AI and predictive analytics, big data, IoT and other technology to find new ways to not only operate more efficiently and with less waste but to more fully build a circular economy – with a focus on eliminating waste and a more responsible use of natural resources.

The Internet of Things will fundamentally change the way we work, shop and live. With the exponential growth in the number of devices, the avalanche of data from the vast array of sources and sensors requires distilling this data into actionable insights. Enter Predix: GE's platform for developing applications for the Industrial Internet is already transforming cities, hospitals and factories. Built on the Pivotal Cloud Foundry platform, Predix offers an operating system for developing, testing and delivering secure software that powers everything from safer jet engines to more intelligent streets.

Dell.to/Predix

Policy Recommendations: Sustainable Development

Government policies and initiatives will be the primary drivers of the SDGs. Governments will need to develop the legal and practical frameworks in support of the SDGs in order to facilitate the significant public-private collaboration and exchange that will be needed to meet the goals. Governments should work with businesses to help develop and implement these frameworks by:

- Working with businesses to use emerging technologies to develop the data tools and mechanisms needed to prepare and implement appropriate strategies to meet the SDGs.
- Leveraging AI, ML, predictive analytics to undertake smart city master plans and develop smarter mobility options, safety, water consumption, renewable power generation and storage, power and water distribution, and healthcare.
- Implementing smart, open data platforms to share their own government data, with privacy safeguards, to foster innovative solutions to societal problems.
- Encouraging businesses to use globally recognized third-party certifications to show compliance with environmental and social standards.
- Promoting development, procurement and use of sustainable goods, taking into account the whole product lifecycle and circular economy principles.

AeroFarms is the world leader for indoor vertical farming and sustainable agriculture. Leveraging science, engineering and Dell technology, AeroFarms is on a mission to transform agriculture. AeroFarms grows high-quality, nutritious leafy greens and herbs without sunlight, soil or pesticides – achieving 390 times greater productivity annually than a commercial field farm while using 95 percent less water.

Dell.to/AeroFarms

Some of the brightest minds and biggest brands count on the power of Dell Technologies to help them bring their ideas to life, and their products to market. Here are additional stories that showcase our customers making the amazing happen every day.

https://www.delltechnologies.com/en-us/customer-stories.htm.

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