

VULNERABILITY SCENARIOS

Driver Forecasts #9: Technology

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Background

Technology has always played an enormous role in lifting populations to higher living standards and improving human health. Over the past few generations, technological change has accelerated to the point where it causes major, visible changes in the world within the span of a single lifetime. Many people born before the Wright Brothers' first flight lived to see the Apollo astronauts land on the moon. Some people born before the invention of the personal computer may spend their entire careers working remotely over the Internet.

Some futurists, such as Ray Kurzweil, argue that technological change is exponential, and that "we won't experience 100 years of progress in the 21st century—it will be more like 20,000 years of progress."¹ The technological progress we foresee as possible by 2030 is less earthshaking, but still substantial.

Some of this progress will benefit vulnerable populations indirectly because it benefits everyone. For example, improvements in energy efficiency and greater use of renewable energy would reduce both energy costs and the air pollution generated by burning fossil fuels. Technological advances could also support the creation of low-cost prefabricated green homes, inexpensive sensors to detect chemical contaminants, and improved public transit systems.

However, other advances may not benefit vulnerable populations at all, or may even increase disparities in income and health. For example, the high cost of some potential advances, such as 100-mpg vehicles or the regeneration of damaged body tissue, may put these technologies beyond the reach of vulnerable populations. Furthermore, advances in automation, telemedicine, and Internet technology could lead to the elimination of many low- and mid-skill jobs,² which would exacerbate vulnerability. In many high-tech industries, advances create a relatively low number of new jobs, and these jobs are mainly for highly trained people.³

In other cases, special policies may increase the availability of new technologies across the socioeconomic spectrum. For example, advances in biomonitoring are likely to include glucose level testing for people with diabetes that does not require finger prick blood testing;⁴ we are also likely to

¹ Ray Kurzweil, "The Law of Accelerating Returns," 2001. Available online at: <http://www.kurzweilai.net/meme/frame.html?main=/articles/art0134.html>

² Simon Etcher, "Technology is a Major Source of Job Loss," November 9, 2008, *Suite 101.com*. Available online at: http://us-trade-policy.suite101.com/article.cfm/robots_are_replacing_workers

³ McKinsey Global Institute, "Five Myths About How to Create Jobs," *McKinsey Quarterly*, May 2010. Available online at: http://www.mckinseyquarterly.com/Five_myths_about_how_to_create_jobs_2526

⁴ Institute for Alternative Futures, DRA Project, The Biomonitoring Futures Project:

have biomonitoring that gives us early warning of diabetes and cancer in its early stages or even pre-disease states. Policy decisions may support putting this technology in the hands of society's most vulnerable members. If managed properly, the evolution of technology offers many opportunities to reduce vulnerability over the coming decades.

Forecasts

The Alpha forecasts represent expectable or "most likely" futures, the Beta forecasts envision challenging possibilities (e.g., what could go wrong), and the Delta forecasts represent visionary or surprisingly successful futures that would have a positive impact on reducing vulnerability.

Alpha Forecast – Technology 2030

The rate of technological change accelerated over the decades leading to 2030, providing benefits for vulnerable populations but allowing privileged populations to pull further ahead. While some stakeholders leveraged new technologies to explicitly reduce health disparities and economic injustice, innovation proceeded with little mainstream regard for the needs of vulnerable populations. The gap between rich and poor has widened, particularly in the areas of employability, health, and learning.

In many respects, advances in technology allowed Americans to "redesign" the world in which they lived. The expansion of public transportation systems throughout the 2010's incorporated the display of real-time arrival and departure information and allowed more flexible routing for vulnerable populations. New fields of "green chemistry" and biomimicry, which model nature's own structures and processes, allowed for environmentally friendly manufacturing processes that did not require the use of noxious chemicals and high temperatures or generate large amounts of waste, particularly air pollution that disproportionately affected low income neighborhoods. Energy-efficient prefabricated "green" homes became increasingly functional, attractive, and inexpensive, shaking up the housing market and providing more options to the poor. A new generation of nanotechnology-based inline sensors has improved environmental health by rapidly detecting a wide range of pathogens and toxins in water and air systems.⁵

Initiatives to evaluate and use new health-promoting technologies were carried out in vulnerable communities. Community health centers helped develop effective cell phone and PDA-based programs for personal biomonitoring, reinforcing healthy behaviors and providing early warning of health risks. Telemedicine, more efficient models for primary care delivery, and better tools for self-care have put

Final Report and Recommendations, November 2006 Report 06-14. Available online at http://www.altfutures.com/draproject/pdfs/Report_06_14_The_Biomonitoring_Futures_Project_Final_Report_and_Recommendations.pdf and Biomonitoring & Disparities: Update and Targets, Summary of a Biomonitoring Update and July 28th 2008 Working Meeting, Final August 2008. Available online at: http://www.altfutures.com/draproject/pdfs/Report_08_02_DRA_Project_Biomonitoring_Update_Summary.pdf

⁵ An estimated 19.5 million Americans, representing about 7% of the entire US population, got sick in 2009 from contaminated drinking water. See Neil Gordon, "American Needs a New Strategy for Safe Drinking Water," *Nanotechnology Now* May 2010. Available online at: <http://www.nanotech-now.com/columns/?article=441>

basic, effective health services within everybody's reach, often through government programs to guarantee universal access.

However, some advances in technologies worsened existing disparities. For example, technologies allowing more efficient operations and automation in factories, offices, and hospitals constrained job growth, especially for low-skilled workers. As a result, many jobs lost in the Great Recession never returned. By 2030, automation has become a significantly larger source of job loss than offshoring and outsourcing. While technology has improved living standards for most Americans, unequal access to new technologies, as well as increased unemployment caused by automation, has reinforced the vulnerability of many communities.

Beta Forecast – Technology 2030

Throughout the 2010's, sharp cutbacks in government spending and corporate R&D, as well as reduced investment in innovative start-up companies, slowed the pace of technological change in areas likely to help vulnerable populations. Lack of progress on alternative energy and a dwindling supply of oil led to significant fuel price increases that disproportionately affected the poor. More low-income households found themselves spending more than one-third of their household income on energy alone. Others found that working at jobs far from their homes no longer made sense once rising transportation costs had been considered.

Lacking money for new investments in technology or infrastructure, many companies tried to get the most out of the facilities they already had. Toxic exposures increased, especially affecting vulnerable communities located near aging and poorly maintained energy and industrial facilities. Lacking alternatives, many poor people continued working in the unsafe working conditions provided by these facilities. Regulators allowed this lax approach to health and safety given the need to “jump-start” the economy.

Where innovation has occurred, it has been funded by the rich and has developed applications that only the rich can afford. New technologies to enhance human capacities, such as through drugs that increase mental acuity and exoskeletons to enhance physical strength and performance, are available to the rich but well beyond the reach of vulnerable communities. In health care, rich communities benefit from expensive treatments for Alzheimer's and other debilitating diseases, while the poor are left living shorter, less fulfilling lives. By 2030, access to technology has become a pronounced structural divide between rich and poor.

Delta Forecast – Technology 2030

Facing the crises of the early 21st century, many looked to technology not only for the next big consumer product but also for solutions to society's greatest problems. Companies and agencies using this approach made an explicit goal of technological development to help vulnerable populations. As this goal was embedded in corporate innovation and in the operation of federal agencies, best practices were developed for engaging vulnerable communities in the innovation process, including incorporating community perspectives in program and research agendas, increasing support for community-based research using new technologies, and including social scientists in the evaluation of technology applications.

Increased funding aimed at developing “game changing” energy technologies made possible significant advances in solar energy, fuel cells, batteries and other areas that keep energy costs down while accelerating the shift away from fossil fuels. Regenerative Medicine became a major field thanks to advances in areas such as tissue engineering, stem cells, and re-growing body parts. Wideband wireless networks became ubiquitous; social networks, prediction markets and many formats unforeseen in 2010 created a radically new information environment.

Advances in sustainable agriculture, urban agriculture, and *in vitro* meat production made healthier foods available at lower costs. An advanced sustainable agriculture emerged drawing on the best from organic farming, minimum input “precision farming,” and advances in biotechnology. Improved methods were developed for urban vertical farming and for produce growing in small spaces.

In the 2020’s, a new manufacturing paradigm emerged based on the ability to manipulate genetic code and operate at a quantum scale with high degrees of precision and reproducibility. Operating at this scale, technologies increasingly converged, accelerating technological evolution by allowing innovations to move between previously separate areas of info-, bio- and nanotechnologies. Nanomaterials and organisms developed by directed evolution were used in a wide range of applications, including technologies to provide low-cost renewable energy (e.g., creating biofuels from algae), increase agricultural productivity, produce inexpensive pharmaceuticals, break down pollutants, make biodegradable plastics, enable better and cheaper water purification, and improve the screening and early detection of disease as well as diagnosis and treatment.

The focus on helping vulnerable populations has produced a variety of novel applications, such as ubiquitous environmental sensors in neighborhoods that have had problems with pollution; interactive “games for health” and supportive online social networks designed for particular vulnerable populations; and successful new treatments for addiction management. Community health centers support the use of cell phones and other user friendly tools for health monitoring and reinforcement of healthy behaviors based on the patient’s choices, lifestyle, and environment. Genome mapping is very inexpensive and everyone’s genome is included in their electronic medical record. Advances in epigenetics and related knowledge allow community health centers and others providing health care to low income populations to increase their effectiveness. All of these developments benefit vulnerable populations by holding down or actually decreasing the costs of food, energy, health care, and consumer products.