

Thoughts on major existential societal issues and their prospective solutions



If peace in the world can be maintained and technology continues its rapid growth, utopian cities of the future will be greener with healthier people living in them with much longer life spans and richer more fulfilling lives.

As artificial intelligence and other technologies are improved, many jobs will disappear. But super-smart machines will make possible enjoyable lives for all.

By Dennis Bushnell
Chief Scientist, NASA Langley Research Center

Society, worldwide, currently faces serious simultaneous issues such as machines taking the jobs, income disparity, a crashing ecosystem, climate change, major shifts in energetics, impacts of population growth, the potential emergence of human level machine intelligence, tele-everything, the rapid development of the virtual age and humans becoming cyborgs.

We have apparently been too successful as a species. We appear to be working ourselves out of a planet and, through technology, working ourselves out of a job. Most of these issues and their effects have serious societal implications and have garnered considerable study individually. This article considers them as an entirety and speculates on synergistic solution spaces.

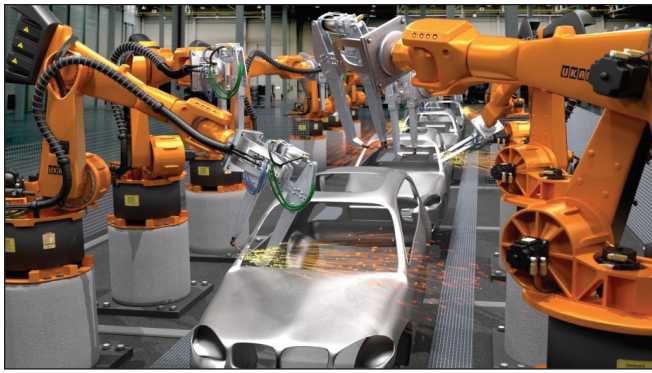
Introduction

Humans evolved over the past million years as superb hunters and gatherers. During the past 10,000 years or so we became an agricultural society and then moved into the industrial age. We currently are in the IT/bio/nano age and are rapidly entering the virtual age.

Nature provided during the hunter/gatherer age. In the agricultural age we learned how to control plants and animals and created a greater economic surplus, enabling the development of civilization. In the industrial age we mechanized agriculture, and the work force went from being mainly composed of subsistence farmers to involvement in manufacturing. In the current IT/bio/nano age we are automating manufacture and much else, and have already started to robotize, increasing percentages of the entire spectrum of jobs.

Along the way we have continued to improve nutrition, increased lifespan and reduced infant mortality, resulting in significant population increases. All of this has occurred in the presence of a finite sized planet with finite resources, whose limits we are again facing.

Malthus, and more recently the Club of Rome, famously raised the issue of human requirements versus what the ecosystem can provide. We have developed technologies to subvert these ecosystem limitations as evidenced by an increasing societal standard of living. But the issue going forward is whether we can continue to do so, as suggested by such books as *Abundance* and *Infinite Resource*, or whether we need to address all these simultaneous issues—along with issues that are not ecosystem strictures but are arising because we have proven far too clever—



Automobile manufacturing is now automated. The UKAK Robotics Corp makes the orange machines shown here building BMWs. The result is perfect never-varying construction with few human workers involved.

and make some serious, synergistic societal changes. Books in this genre include *The End of Growth*, *The Crash Course*, *The Great Disruption* and *X-Events*.

The following issues in this connection are our wicked problems as a society.

Machines taking jobs

We have produced machines that were first automated, then robotic and now are now becoming autonomous, and these machines have been increasingly replacing humans in the labor force. The IT revolution has produced machines that perform many tasks faster, know far more and make fewer mistakes than humans while being more economical overall.

This trend has been documented and discussed in many books and articles.

So far, the responses to this—aside from ever continuing job losses—have been mainly of 2 camps. Some point to previous similar job displacement in agriculture and manufacturing, and they have faith that we will repeat that experience via new job creation, although few provide specifics as to what jobs we'll create this time. Others state that we have never been here before, never created a 2nd intelligent species before, and the outlook is for a continuation of ever more job losses as highly intelligent robots and machines continue to develop. Their solution space usually comprises some sort of guaranteed income supported by the productivity of the machines, with humans doing something that is usually termed "life enriching".

Humans have always had to earn their bread, but now it seems that we may be on a technological track where that may not be necessary. So we may have to revisit this basic tenant of the human existence theorem.

Driverless vehicles are an example of upcoming serious additional job losses to the machines. Truck drivers constitute a sizable portion of the labor force. All the US armed services have an avowed robotic future. And there are also proposals for avatars instead of human teachers for tele-education, and knowledgeable machines that could replace doctors for telemedicine.

Crashing ecosystem

There is a considerable agreement that there are too many humans consuming too many resources. We are currently short some 40 to 50% of a planet and the situation is becoming more dire.



Global warming is at least partially responsible from man's pollution causing climatic extremes. A drought in Wichita Falls TX has caused area lake levels to drop, forcing the city to adopt emergency water restrictions.

Water shortages, species extinctions, pollution, loss of topsoil and habitat, depleted fish stocks, deforestation and climate/CO₂ issues are part of the evidence. We have tried, in various places and times, to reverse some of this—especially the pollution—with some success. However, the metrics are becoming ever worse overall. As billions of Asians attempt to attain Western living standards, we are projected to be short some 3 or more planets and we will have seriously despoiled our nest.

The major solution space for the ecosystem destruction issue is, of course, sustainability across the board. There is ever improving technology to enable such an approach, but this would be a major turn in economic affairs. World econometrics are based upon growth, and sustainability may not support such growth except in niche areas. Overall, depending upon technology details, there is the possibility for reductions in our current standard of living accompanying sustainability across the board, but probably not as great a reduction as would ensue if we continue to despoil the ecosystem.

Climate change

Reports by the Intergovernmental Panel on Climate Change (IPCC) summarize the major rational and projections for climate change. These reports are proving to be conservative, many suggest due to the lack of full inclusion, from a dearth of applicable science of the many positive feedbacks. These feedbacks include releases of fossil methane (some 22X CO₂ effects) and fossil CO₂ from the tundra and oceans, the decreases in ocean CO₂ uptake, the algae reductions, the albedo changes as the ice melts and the ever increasing amounts of water vapor. Simplex estimates of the potential impacts of these positive feedbacks indicate up to a doubling of the IPCC temperature rise projections. The impacts of climate change are many and quite dire, including ocean rise, weather changes, floods, droughts, diseases and more ecosystem changes. Probably the direst is that we replay the Permian extinction on steroids.

The current anthropogenic CO₂ release rate is estimated to be 2 orders of magnitude greater than that from the Siberian volcanoes that triggered the Permian. In that event, as the ocean thermal-haline circulators died, the oceans went anoxic, enabling an overgrowth of anoxic bacteria that produced much hydrogen sulfide, which in not that large an amount makes the atmosphere poisonous and takes down the ozone layer. The Permian is also known as The Great Dying.



The Nellis Solar Power Plant is located within Nellis Air Force Base in Clark County, Nevada, northeast of Las Vegas. the Nellis solar energy system will generate in excess of 25 gigawatt-hours (90TJ) of electricity annually and supply more than 25% if needed power used at the base.

The possible solutions for our planet's climate issues and other challenges are renewable energy approaches. There are many such and their capacity is orders of magnitude greater than the fossil carbon utilization. Moreover, technology developments over the past decades have dropped the costs of renewables below the fossil carbon energy price point. Renewables account for over half of our new generation production now and that percentage will increase going forward due to economics.

Population growth

Human population—a major determiner of the ecosystem shortfalls—has tended ever upward due to technology developments that have reduced infant mortality and increased health and economic wellbeing. But more recently, birthrates have been reduced by the advent of education for women, their inclusion into the work force and consequent independence. It's important to synch the birthrate with our planet's sustainability and the desired standard of living. And it's of special interest that the bio revolutions are projecting serious increases in lifespan. We are currently stretching human life by some 0.2 to 0.3 years per year and, with the genomic and synthetic biorevolutions and nanotechnologies, some are projecting major increases that approach to 1 year per year.

Development of super intelligent machines

In terms of machine speeds, we have come some E8 on silicon since the late 1950s. Going forward as we move from silicon onto bio, optical, nano, molecular, atomic computing along with 3D and massively parallel architectures, the estimates are greater speeds from E8 to E12. Then there is quantum computing, projected to have far greater performance.



Honda keeps improving Asimo, acronym for Advanced Step in Innovative Mobility, so this robot can now walk up and down stairs, run and even play soccer. Asimo's hand and finger dexterity along with the robot's intellect are also improving. Future uses for Asimo include being an alert never-sleeping 24-hour medical attendant, becoming a space traveler and serving in businesses ranging from banks to restaurants.

Current machines—at 30ish petaflops—perform at human brain speed, going forward obviously far faster.

The issue is machine intelligence. Artificial general intelligence at human level could arise from “emergence,” the same way the humans evidently acquired intelligence. In other words: Make something complex enough and it “wakes up.”

But there are also the human brain projects, which nanosection the neocortex and replicate it with silicon to emulate the brain. Finally, there are efforts to create software and algorithms that work at a human level.

Brain emulation is the current favorite. Many ask not if but when will it be a reality. And it could be just decades away.

The concern is that human level and beyond human level machine intelligence, coupled with the far greater speed, knowledge and machine connectivity could be detrimental to humans. Many books and articles have discussed this issue overall, and there is currently a dichotomy between the people who say we will never develop such machines and those who are seriously worried about the aftermath and are thinking of safeguards to ensure such machines remain friendly to their human creators, if such is possible.

Tele-everything in the virtual age

As a direct result of the IT revolution, society has long been on a path to essentially do everything from a distance. This is well along and includes telecommuting/teleworking, teleshopping, tele-education, telemedicine, teletravel, telecommerce, telesocialization, telepolitics and telemanufacturing.

As we develop the 5 human senses for virtual reality to make immersive presence even better, the world and society will shift even more to tele-everything. The impacts of this vast shift upon jobs and human employment are almost incomprehensible.

This shift strongly suggests a change to the Toflerian prosumers behavior. Electronic cottages, off all the grids, with on site 3D printers could allow the prosumers to manufacture what they need, prescinding from employees in an industrial setting. This will eventually cause atrophy of much of the current centralized econometrics. Just imagine a “do it yourself” (DIY) society on steroids, where folks are able to live wherever they want and however they want, with IT-enabled vastly updated subsistence farms on smallish sites, shifting from centralized urban centers back to areas with sparse population.

Also, decentralizing whatever physical travel is required so individuals can utilize personal flying vehicles from their home, which is now doable—and will become more so—thanks again to the IT revolution and its projected benefits to current ATC systems.



Lockheed Martin has created the FORTIS exoskeleton which can add strength to the human body and boost worker productivity up to 27 times the normal rate. Factory worker applications and military uses are being studied.

Humans becoming cyborgs

For centuries we have used technology to augment our human capabilities. The obvious earlier devices include glasses and hearing amplification, but research and current technology have produced such helpful advancements as artificial retinas, artificial hearts, printed organs, direct brain to artificial limb control and brain chips. These last thus far correct brain defects, but work is underway to improve brain functionality and capability to effectively move the hand-held device, as it develops, into the head with direct communications to the augmented brain vice through the senses.

These augmented human capabilities supply competitive advantage and promise a greater substitution of mechanisms writ large for the current “wet electro-chemistry.” The transhumanists are tracking and sometimes promoting all this.

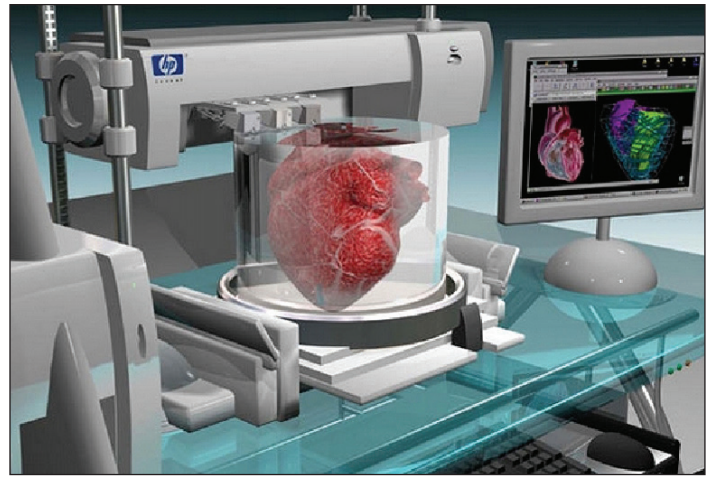
The ultimate possibility that has been discussed is up-loading the brain into a machine, which would have god-like knowledge and would be connected to the emerging global sensor grid and global mind. As Moravec has discussed, we morph into our “brain children” and then we would become human contaminated machines.

The current evolution of just about everything (the planet, the humans, life forms) appears to be now in the hands of the humans, it’s over a million times faster than any natural evolution. And given the envisaged technology developments, merging human capabilities with our machines is not that far fetched.

Emerging technologies with potentially massive societal impacts

Besides these major societal issues, the many game-changing emerging technologies need to be considered in terms of both problem and solution spaces.

These technologies include quantum computing, distributed renewable off-the-grid energy generation, molecular manufacturing, education and medicine delivered via web-based intelligent avatars, synthetic biology for both bio production and bio functionalism (living products and those produced by living organisms), halophytes, salt plants grown on wastelands with seawater



A near-magical medical breakthrough is now occurring with 3D bio-printing of tissues and organs that are finding applications in tissue engineering, research, drug discovery and toxicology.

irrigation to solve land, water, food, energy and climate needs, autonomous robotics and machine creativity/invention—developing rapidly.

These and other issues could alter societal conditions such as sustainability, the capability of the DIY prosumers and the end game for the machines taking human jobs.

Conclusions: The overall outlook for society

All these serious simultaneous issues and changes should lead to a greatly increased lifespan and solutions to land, water, food, energy and climate matters. They should also assure continued decreases in the costs of goods and a major shift to the DIY prosumer who lives away from urbanization. They should guarantee human augmentation and essentially free education and medicine, along with a demise of the current growth based centralized econometrics and employment per se.

Such changes could of course create angst and unrest in the run-up. As with nearly every great societal change, there will be a great shift in winners and losers. As technologies develop and enable individuals to be economically independent, the great income disparities disappear. Sustainability and renewable energy appear to be a given. Anything less leads to truly existential issues, possibly mitigated by technological developments.

Restoration of the ecosystem and climate are not off the table if society makes the shifts that are potentially permissible. Also, the prosumer—a DIY via advanced technologies—shifts from centralized economies and infrastructures. This provides great personal empowerment for everyone and should result in a stable, human, planetary environment and society. ✈️



Dennis Bushnell is chief scientist at the NASA Langley Research Center, where he is responsible for technical oversight and advanced program formulation. His major technical expertise includes flow physics and control, drag reduction and advanced configuration aeronautics. Bushnell is a fellow of AIAA, ASME and the Royal Aeronautical Society and a member of the National Academy of Engineering.