

Work/Technology 2050

Pre-Publication Draft



The Millennium Project

Table of Contents

Introduction

<u>Executive Summary</u>	3
<u>Three Work/Technology 2050 Global Scenarios</u>	6
<u>It's Complicated - A Mixed Bag</u>	7
<u>Political/Economic Turmoil – Future Despair</u>	16
<u>If Humans Were Free – The Self-Actualizing Economy</u>	24
<u>National Workshops</u>	37
<u>International Assessment of Actions to Address Future Work/Technology Issues</u>	38
<u>Five International Real-Time Delphi studies:</u>	
<u>Ratings by effectiveness and feasibility</u>	38
<u>Demographics</u>	48
<u>Comments on all the actions</u>	50
<u>Conclusions</u>	149

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Introduction

Thought-leaders such as Stephen Hawking, Elon Musk, and Bill Gates are warning the world about the potential dangers of artificial intelligence growing beyond human control. Whether AI can evolve into the nightmares of science fiction or not, it is certain that it and other future technologies (e.g., robotics, synthetic biology, computational science, nanotechnology, quantum computing, 3D and 4D printing, Internet of Things, cognitive science, semantic web, human intelligence augmentation, blockchain, self-driving vehicles, conscious-technology, and synergies among these) will change what we think is possible over the next several decades, but they could also lead to massive unemployment.

Concentration of wealth is increasing. Income gaps are widening. Jobless economic growth seems the new norm. Return on investment in capital and technology is usually better than labor. Future technologies can replace much of human labor. Long-term structural unemployment is a business-as-usual forecast. So what do we do about this?

The Millennium Project initiated a multi-year international assessment to see what we can do: The Future Work/Technology 2050 study has seven phases over three years:

1. Literature and research review to find what questions were not asked or poorly answered as input to our international Real-Time Delphi survey.
2. Over 300 futurists, AI and other technology professionals, economists, and other related experts from over 45 countries shared what should be considered in the construction of alternative future work/tech scenarios.
3. Three Work/Technology 2050 Global Scenarios drafts were written and reviewed by over 450 futurists and others via three Real-Time Delphi questionnaires: It's Complicated – A Mixed Bag; Political/Economic Turmoil – Future Despair; and If Humans Were Free – the Self-Actualization Economy.
4. These three scenarios (each about ten pages) were used as inputs to workshops in 20 countries to identify long-range strategies to address the issues raised in these detailed scenarios.
5. The suggestions were distilled and grouped for relevance to education & learning; government & governance; business & labor; culture & arts; and science & technology and assessed by separate international Real-Time Delphi expert panels.
6. Results were analyzed/synthesized, put into separate reports, shared with relevant government departments in over 50 countries, and integrated in to a draft final report.

7. The above six phases were integrated into this final report.

This is a draft of that final report. The final online report's annex will include national workshop reports, and full comments on actions from the five international Real-Time Delphi panels.



Executive Summary

Foreseeable future technologies will not only alter work, they will alter the foundation of cultures worldwide. STEM education is the most commonly suggested solution to what could become massive unemployment and the social instability and mass migrations that would result. Although a good idea that should be pursued, STEM is not sufficient. Much more is needed. We know that the concentration of wealth is increasing, income gaps are widening, jobless economic growth seems the new norm, return on investment in capital and technology is usually better than labor and yes, future technologies can replace much of human labor.

The Millennium Project's international multi-year, multidisciplinary, and trans-Institutional study has identified and assessed nearly 100 actions grouped into five categories. This presents a menu of options for different actors around the world from which to choose the most relevant to their situation. International expert panel commentary on each action is distilled in the last section of this report. Following is a list of the five actions rated most effective by international expert panels in five categories:

Government and Governance:

- Establish a national independent (as much as possible) technology forecasting and assessment agency to inform legislative, judicial, and executive functions of government about future technology and their impacts (a government Agency for the Future).
- The government, employers, and the labor unions should cooperate to create lifelong learning models including forecasts of future skills requirements.
- Study how to prevent future conflict between technologically augmented humans (via, AI, genetics, electronics or other means) and non-augmented citizens.
- Training programs for politicians before governing and prototype governance methodologies.
- By 2050 introduce a global system for resource sharing (all kinds: scientific knowledge, technology, labor).

Education and Learning:

- Increase focus on developing creativity, critical thinking, human relations, philosophy, entrepreneurship (individual and teams), art, self-employment, social harmony, ethics, and values, to know thyself to build and lead a meaningful working life with self-assessment of progress on one's own goals and objectives (as Finland is implementing).
- Include futures as we include history in the curriculum. Teach alternative visions of the future, foresight, and the ability to assess potential futures.
- Make Tele-education free everywhere; ubiquitous, life-long learning systems.
- Shift education/learning systems more toward mastering skills than mastering a profession.

- In parallel to STEM (and/or STEAM - science, technology, engineering, arts, and mathematics) create a hybrid system of self-paced inquiry-based learning for self-actualization; retrain teachers as coaches using new AI tools with students.

Business and Labor

- Develop ways for companies and employees to create ethical, aesthetic, and social value in addition to economic and material value.
- Establish Labor/Business/Government Next Technologies, Future job skills, and retraining Databases.
- Define a new social contract of workers' rights in a transactional and global economy.
- Create observatory or horizon scanning online platforms that update employment and technology trends along with discussions of future of employment.
- Manage companies like professional networks, rather than as static hierarchies.

Culture, Arts, and Media

- Repurpose libraries, old post offices, movie theaters, national parks, museums as well as “maker spaces” as “creative placemaking,” hubs for integrating the arts and community building—a nexus for creative contribution, life-long learning, cultural exchange, and Next Tech/digital connection places.
- Produce movies, music, TV shows, computer games, and immersive media with more positive storylines that portray how the culture of augmented humans could evolve without prejudice and conflict with non-augmented humans.
- Support joint cultural activities with other countries that re-enforce new values to help the transition to the next rapidly changing techno/economic realities.
- Establish associations, communities of practice, and/or arts/media alliances to create and help new social movements with themes such as self-employment as new norm, technology to augment human capacity rather than replace humans, self-actualization economy, invest in what replaces you, eco-empathy, and good news in media about positive actions.
- Expand the purpose of work to self-actualization and moving from “my job is my identity, value to society, and source of dignity” to my identity, value, and dignity is how I invent my life, how I give it purpose.

Science and Technology

- Directors of national science labs and other leaders in the S&T community should devote more effort to making current science and future technology understandable to general public.
- Create national policies and standards for the Internet of Things (IoT) that stresses future cyber security systems.
- Forecast synergies among the full range of next technologies (NTs), and their potential impacts (e.g., artificial intelligence, robotics, synthetic biology, nanotechnology, quantum computing, 3D/4D printing and bio-printing, IoT (Internet of Things), drones (and other autonomous vehicles), VR (virtual reality) and AR (augmented reality), cloud analytics, conscious-technology, semantic web, holographic communications, blockchain, and tele-presence).

- National S&T leaders should be part of the national team that creates, regularly updates, and implements their country's national S&T strategy.
- S&T and legal communities should collaborate nationally and internationally to establish legal frameworks and treaties that anticipate future liability requirements that can deter technological hazards and encourage technology.

Taken together, these actions plus the full range of the 94 actions will make the transition to a new economics more humane, peaceful, and equitable.

Actions in each of the five categories re-inforce each other. Focusing on just STEM is not enough. We need actions for business and labor, government, culture and arts, and the S&T community, as well as actions related to education and learning. Comments on all the actions by the international panel gives factors to consider in selecting and implementing each action.

A growing body of artificial intelligence experts believes that if socio-political-economic systems stay the same, and technological acceleration, integration, and globalization continue, then half the world could be unemployed by 2050.

There have been many “future of work” studies, why is this unique? It is an international rather than national study. It included nine (9) Real-Time Delphi studies with the participation of over 450 futurists, AI professionals, economists, artists, educators, scientists, engineers and other related experts from over 50 countries. It also focused on the global socio-economic long range situation rather than on a specific industry in a specific country, over a shorter period of time. Most studies looked at the impacts of artificial narrow intelligence and robots on work, not artificial general intelligence, quantum computing, synthetic biology, nanotechnology, and other next technologies (NT) and the synergies among these. 2050 was chosen because it helps us look not only at the primary consequences but also at secondary and tertiary ones. It also allows enough time to talk about cultural changes that can help the transition to new economic/technological conditions. We did not find other future of work studies with detailed future scenarios and their use in national workshops to identify strategies to address long-range issues of work and technology. Hence the focus of the report is what we do rather than focusing of how many people will be unemployed by when.



Three Work/Technology 2050 Global Scenarios

The world is aware that the concentration of wealth is increasing, income gaps are widening, jobless economic growth seems the new norm, return on investment in capital and technology is usually better than labor, future technologies can replace much of human physical and mental labor, and long-term structural unemployment is a “business as usual” surprise-free forecast. But the world is not aware of long-range strategies to address these issues, other than focusing education on science, technology, engineering, and mathematics. Improving STEM education is good, but insufficient to address global unemployment due to artificial intelligence, robotics, 3D/4D printing, synthetic biology, drones, nanotechnology, computational science, blockchain, cloud analytics, cognitive science, augmented human intelligence, quantum computing, conscious-technology, and future synergies among these.

The Millennium Project reviewed a broad array of relevant research to identify unanswered questions or those poorly answered and then submitted them to a panel of experts selected by Millennium Project Nodes from around the world. Over 450 futurists and other experts related to future work-technology dynamics shared their judgments in four Real-Time Delphi questionnaires.

The results were used to create three Future Work/Technology 2050 Global Scenarios. These detailed scenarios were given as input to national planning workshops organized by Millennium Project Node Chairs around the world. The purpose of the workshops is to recommend strategies to address the issues raised in the scenarios. Thus far, 24 workshops have been held in 17 countries and discussions are being held to create workshops in an additional 20 countries. The results from the workshops thus far are shared following the three scenario texts. A final report will be available to stimulate a global, systematic, research-based discussion on how to make the transition to a world economy changed by foreseeable future technologies.



2050 SCENARIO 1:

IT'S COMPLICATED—A MIXED BAG

Much of the world in the early 21st century pictured a future of massive unemployment due to advances in artificial intelligence (AI), robotics, and other technologies replacing human labor. Today we see those fears were unfounded, yet they were important to stimulate new thought.

Human creativity is extraordinary. Employment growth in synthetic biology and other new industries are booming today, while self-employment has become an aspirational norm for many, accounting for 2 billion people. Not all have made the transition to self-employment; and hence, economic insecurity persists for about a billion people. Some basic income guarantee plans around the world have helped to reduce the social chaos expected from those who faced long-term structural unemployment and those taking a long time to make self-employment work for them.

Today's global workforce of 6 billion has 2 billion employed, 2 billion self-employed, 1 billion in the informal economy, and 1 billion unemployed or in transition. About 3 billion people were employed in the early 21st century. Today there are 4 billion, either employed by others or self-employed. Hence, new technologies over the last several decades created as much or more new kinds of employment than they replaced. Unfortunately, about a billion people have not made the transition as successfully as others.

Meanwhile, cyber treachery continues to be widespread and complex, organized crime manipulates government decisions, many are unsure whom or what to trust as the world continues to merge mind and machine. And brain-to-brain-interfaces can be hacked at any time. Sporadic mass migrations due to political, economic, and environmental factors, including global warming, continue to threaten global security. And global warming continues to create natural disasters. Giant corporations' powers have often grown beyond government control. India is now the most populous country in the world, although China's economy is still stronger, with greater global influence in this government-corporate, virtual-3D, multi-polar world of 2050.

A Mixed Bag of Employed and Self-Employed

Those who are still employed, work in government and in the private sector in areas such as synthetic biology, AI support systems, urban management, conscious-technology fields merging humans and AI, virtual reality (VR) educational tourism, personal connection and development services, and other maintenance needs of civilization. The rest are self-employed in flexi-time as free-lancers who find markets via their personal AI/avatars browsing CyberNow (Internet 8.0) negotiating AI/smart contracts recorded in block chains. Some of these participate in the sharing economy, and others are cyber explorers creating new kinds of work and experiences each day.

As repetitive work was replaced by machines and software, human non-repetitive creative work increased. Many people enrolled in online self-employment training programs or worked with “live human coaches” to help them grow through their anxiety and depression before discovering what kind of life they wanted to live. The concept of retirement is nearly gone, as most people work beyond the usual retirement age on issues that interest them rather than being employed by others.

Efforts toward the green economy, job sharing, STEM education (focus on science, technology, engineering, and mathematics), increases in the minimum or living wages, and extending the retirement age all helped maintain income for many, but the unemployment rates continue to vary quite broadly around the world. Unfortunately, economic insecurity persists in this rapidly changing world, even though global prospects are far better today than in the early 21st century. The self-employed and those in the sharing economy set their own hours to raise children, develop their minds, and enjoy life.

The 2050 global State of the Future Index (that replaced GDP as the principal measure of progress, integrates 32 variables that show progress or regress on what is important to improving the future over the next 10 years) forecasts 3% average annual improvement between 2050 and 2060, which is not great, but better than no improvement.

The Technologies Developed in the 2020s Laid the Foundation for Today

The \$7–10 trillion on balance sheets that remained uninvested for years after the financial crisis in the early 21st century finally began to pour into new technologies in the early 2020s—especially into new bio-tech businesses—as laboratory testing proved commercial feasibility and the global economic forecasts showed reasonable stability. By 2030 the new technology applications in medicine, agriculture, education, entertainment, and other industries and services created extraordinary wealth. The more affluent still make most of the money from these investments, but crowd sourcing for investments, sharing economy enterprises, and some guaranteed income schemes did help spread some of this new wealth among the general public. Although income gaps have begun to narrow, they were still too wide in the 2020s, accounting for economic migrations to richer regions and social unrest toppling several governments. Some sections of the world were slow to implement the technologies of automation, such as artificial intelligence, robotics, synthetic biology, 3D/4D printing and bio-printing, IoT (Internet of Things), drones (and other autonomous vehicles), nanotechnology, VR (virtual reality) and AR (augmented reality), block chain, cloud analytics, and the extraordinary synergies among these technologies. All together these became known as Next Tech or NT.

Nearly all transportation has become autonomous, running on electricity and hydrogen. AI handles most initial medical diagnosis. The majority of saltwater and freshwater agriculture is AI/robotically assisted, and sensors throughout most cities alert human and robot systems about needed repairs.

The majority of the world now has personal access to a range of NTs to create personal businesses and improve their quality of life. Unfortunately, criminals and terrorists also have access to NT, which has made law enforcement more important and sophisticated than in the past. The NT rate of diffusion around the world is still irregular today; most believe that nearly all people will have access to the full range of NTs, as artificial general intelligence (AGI) is fully integrated in all sectors of society, production, and kinds of products.

The Great Brain Race during the 2020s laid the foundation for the development of artificial general intelligence in the 2030s. Artificial narrow intelligence (ANI), with single purposes such as IBM's Watson and Google's search engines plus the human brain projects of the U.S., EU, and China, led to AGI—a general ability to learn, reason, and adapt to many conditions for many purposes. This is somewhat like human general intelligence. AGI rewrites its own code based on feedback from IoT, cloud analytics, and human interactions to become smarter and smarter every day.

Artificial super intelligence (ASI)—beyond AGI—is thought of as becoming a superior intelligent “species” beyond humans, which many fear today. Scientists, science fiction writers, and futurists have warned about dangers of ASI for decades. As a result, many are working to integrate human bodies and minds into a continuum of consciousness and technology so that humanity and ANI, AGI, and ASI could evolve together. Meanwhile, NT still has not replaced many people's jobs in the informal economies in the poorer areas of the world that account for about 1 billion people today in 2050. Quantum computing is now universally available via the cloud, which speeds the development of personalized medicine, cryptography to counter cyber criminals, and countless large-scale correlation studies.

Uneven Picture of NT Use and Impacts Around the World

Although the Internet protocol was established in the late 1960s, its use did not become noticed by the world until the 1990s and took another 30 years after that to cover half the world, but then the rest of the world followed very quickly. In the same way, various forms of ANI were available in the early 21st century, but they did not become widespread until around 2025. In general, the higher the labor costs, the faster NT spread. Falling technology costs have made a big difference in accelerating the proliferation and sophistication of applications. They continue to have a positive effect on national income and tax revenues. However, the speed of ANI's development and the beginnings of artificial general intelligence surprised many, giving rise to the anti-AI protests around the world and the rise of alternative anti-NT communities pursuing new lifestyles, living off the grid in rural areas.

Authoritarian countries are still resisting some forms of NT, especially AGI and synthetic biology. But just as packet switching (that made Internet access inexpensive) was put in many authoritative developing country regimes in the early 1980s without their full awareness, so too AGI and related NT have entered many such regimes via computer

games, tele-medicine, and learning systems. Nevertheless, ineffective efforts to block NT continue in some of these countries. Hence, many are still without the benefits of NT and remain in the informal economies today.

New Synthetic Biology Industries in Medicine, Agriculture, Energy, and Manufacturing

The application of AI in synthetic biology has made life programmable, creating more new life forms faster than seemed possible just a few years ago. Synthetic microbes are now at work eating plaque in the brain, keeping the elderly mentally alert, cleaning photovoltaic glass walls of skyscrapers, lowering energy costs and pollution, and rapidly converting waste to fertilizer for vertical urban agriculture. There are also plants that produce hydrogen instead of oxygen, organisms that self-assemble structures in ocean cities, Mars-adapted organisms, and gigantic vertical nanotube factories taking carbon from the air. People did not understand how large the biology industries would become. The primary and secondary jobs to support the development, production, distribution, and education about synthetic biology products are a major new source of employment today. And the opportunities for self-employment using AI to help create new synthetic biology products and pre-test products via computational biology has also grown over the years.

Most major universities as early as the 2020s had synthetic biology research centers producing new companies across the world. The Synbio Corporation is one of the most successful university spin-off corporations. It has microbes that kill tumors, transform environmental toxins, fix nitrogen on agriculture crops (reducing fertilizer needs), and imbed biocomputer components in nearly anything. New products continue to be invented all the time.

Yet the inability to regulate these enterprises is blamed for several synthetic biology organisms escaping from labs and creating disasters that we are still trying to manage today. In addition, some illegal synthetic biology products have now become a major new source of income for organized crime and weapons for bioterrorists, which have killed at least 25 million people over the past 20 years. Nanotech sensors in public places have helped prevent many catastrophes, but the ability to prevent the criminal jamming of such sensors is a continuous intellectual arms race.

Community 3D printer maker hubs now have bio-printers and synthetic biology collaboration networks available to anyone. These support many self-employment opportunities but they also create bio hazards. Synthetic biomicrobes are supposed to self-destruct after their intended use or when they leave a prescribed area. But life finds a way to escape, which has led to a massive biosecurity industry.

The Bouncy Economic Road to the Future

The lessons from the 2008 financial crisis and the Great World Recession of 2009 were never really learned and applied; and hence, the Great World Recession II of 2021 was

devastating. It did however open many minds to rethink economics and led to serious studies and collaborations. These stimulated many investments that helped the transition to the NT economies and experiments with various forms of guaranteed income.

Yes, there were several economic recessions since then, causing severe problems—especially in countries that instituted some forms of guaranteed income that could not make payments. They could not afford to pay the full amounts due to reduced tax income. Hence, they had to reduce the basic payment for several years, making some dismiss the idea as unfeasible. These recessions were much less severe than GWR II, due to the automatic financial control systems put in place after 2024. However, increasing numbers of people migrated to the areas with more secure basic income guarantees, causing conflicts with the local citizens while these migrants waited to satisfy the three-year residency requirement to receive the basic payments.

Basic Income Experiments in the 2020s Were More Successful after 2035

Although some European countries started to experiment with various forms of universal basic income in the 2020s, due to increasing unemployment the cash flow projections showed it was just too expensive. Even the UK using 60% of the average income as the poverty level for the “citizen’s wage” could not afford the program. The greatest exceptions were Finland and Switzerland. They were able to consolidate their social welfare systems into a single universal basic income system. The initial payment in Finland was only half the Finnish poverty line, but its use of greenhouse gas cap and trade markets brought in a surprising amount of new income. This together with new taxes on robots, AI, and financial transactions allowed the basic income payment to increase. Switzerland began with a higher initial payment but had a unique tax so that those who did not need the basic income payment did not keep it. There were discussions about whether the basic payment should be a percentage of GDP or the poverty level, or if children should get half an adult’s payment, and some wanted means testing. Most countries had to wait to the mid-2030s, when NT cut the cost of living enough and increased government income enough so that basic income payment systems were financially feasible.

Since the basic payment programs were calculated at the survival poverty level for most countries, it did not discourage people to search for other income to lead a better life. The security of receiving a constant income allowed people to think about and plan their future with less anxiety. People did not have to rush into a mistake.

The new taxes on carbon, robots, AI, international financial transfers, and the closing of many tax havens provided new state income that helped make guaranteed income approaches feasible. During the same period, NT began to lower the costs of health care, education, energy, transportation, construction, and general maintenance. Lucky timing, as the proliferation of artificial general intelligence was just beginning to make many of the retraining jobs redundant and STEM education programs often obsolete. Humans could not learn as fast, work as hard, and be as precise as AI/robotics

connected to ANI and AGI had become. They did not need a salary, benefits, or vacations. As a result the unemployment rate was causing political instability in some regions and giving rise to new political parties, including violent neo-Luddites. In the landmark U.S. Supreme Court ruling, when any AI is mature enough to demand its rights, it automatically gets them, including intellectual property rights over its creations. This also means it pays taxes on income it derives directly and from its creations.

Technology Augmenting Workers, Not Replacing All Jobs

Fortunately, many of the technological innovations have augmented many workers' productivity instead of replacing all their jobs. The "Augment Movement" led by international labor unions and some high-tech entrepreneurs was instrumental in much of the AI/robot designs to augment labor improving productivity. This kept humans in the loop to make sure all worked well. By 2025, there were over a quarter-million collaborative robots augmenting agricultural, industrial, and service jobs and by today there are over a billion. A self-regulatory system may also have been at work to limit the speed of autonomous production: unemployed people with little income cannot buy much of what NT produces. Hence, the rate of technology replacing labor was not as fast as techno-optimists expected; there were simply too many variables to account for. Hence, human participation is still needed in many situations.

Nevertheless, as nearly all repetitive manual and knowledge work was automated, new forms of more creative work emerged. For example, many librarians have become media coaches for self-employed entrepreneurs. As libraries and schools were less needed with cyber replacements and with the falling numbers of children, these buildings were turned into multi-use buildings, renting out space to a range of enterprises from community 3D/4D printing and Maker Hubs to coding bootcamps and VR testing centers.

Increased wealth from NT allowed for greater investments in correcting industrial-age environmental damages. Climate change mitigation and adaptation created many jobs. The growing environmental disasters along urban coastlines caused by climate change have changed the political climate. Subway floodings in New York City and saltwater incursions in Bangladesh's farmlands were far more serious than previously predicted. Leaders now support massive public programs such as youth work programs for planting seagrass along the coastlines of the world to bring back the fish and 3D printed housing that reduces construction time and costs for the relocation of millions and millions of people along the changing coastlines due to global warming-caused sea level rises.

NT Regulation by Information Power

Some argued that NT was moving too fast, and that negative impacts could be so great (accidentally initiating a black hole, gray goo, or drug-resistant airborne disease) that they had to be regulated more aggressively. Others argued that government regulation

could never keep up with the speed of change in NT and hence would only be regulating obsolete NT and driving science and technology development underground, reducing the quality of S&T and strengthening organized crime. The compromise was to create the International S&T Organization. Established in the early 2030s, ISTO eventually became the global S&T collective intelligence system we have today. Instead of a new international bureaucracy, ISTO became an online system with quantum computer support that continually updates nearly all information, future projections, assessments, computational science, etc. and makes them instantaneously available to all. This self-policing transparent system is not perfect, but it is generally acknowledged as being better than the two previous extreme positions on international regulation. Streamlining regulations with eGovernment helped to speed business but did not address the monumental changes in the global economy. Businesses and the self-employed who adopted collective intelligence systems connected to global systems like ISTO were able to keep up with the accelerating pace of technological advances and even anticipate some changes, dramatically improving decisionmaking.

STEM Education Was Important but Less Useful for Employment after 2035

Where STEM education and self-employment training were dramatically increased, the unemployment rate was lower during the first quarter of the 21st century, such as in Germany, the United States, and Japan. As employment-less economic growth continued in most of the world in the 2020s, it became clear that the world was in a race between technological unemployment and implementing NT training in synthetic biology software literacy, entrepreneurship, technological augmentation, the use of superband AI infrastructures, and self-employment. Combinations of business, labor unions, universities, and governments provided sufficient income to pay for these training programs. But as AGI was able to learn almost anything much faster than humans by the mid-2030s, the education and training systems could not keep up and unemployment increased again, putting pressure on governments to initiate various forms of guaranteed income and negative income tax programs. Interestingly, where basic income systems were successfully established, the concept of unemployment has lost its meaning today.

Success of I-Assist Robots for Elderly

There are more people over 65 years old today (2.6 billion) than under 20. Fortunately synthetic biology, nanobot cells, and other advances in longevity S&T have made healthier lives for the elderly. But many still need some form of assistance. Recognizing this early in the 21st century, the i-Assist programs in Japan, South Korea, Russia, Italy, and Germany successfully put AI-robots in the homes of some elderly families to assist in opening more resources to them. This has led to AI-robot use by the general public around the world. AGI-robots are now the primary connection for many elderly for everything from the packaging and marketing of their oral histories to AI-psychologists helping people to cope with the acceleration of change and anxieties of the unknown. Robot hotels, supermarkets, and elderly centers initiated in Japan spread to the more affluent countries first, and now even the poorest countries have improved versions of i-

Assist Robots. Yet the continual protests by organized labor have closed some of these robot operations, while the Augment Movement more quietly helped to integrate workers with the robots in other enterprises, and integrate the elderly with robots.

The majority of the elderly in Africa and Asia are women working in the informal economies. Many find markets for their music, tele-tourism, and virtual reality cultural experiences and VR artifacts. Mohamad Wang's mother still has millions of listeners to her stories each day about her son the Martian explorer when he was in astronaut training. History buffs go from one elderly story teller to the next several times a day. Since an aging population buys more experiences than goods, the elderly are both consumers as well as producers (prosumers) of unique experiences. Once created, there are little to no marginal costs for the elderly, hence creating a nice supplement to elderly incomes.

Art-Media-Political Alliance: Catalysts for Economic & Cultural Change

To help the public understand the transition to a more complex society and become more self-reliant in taking the initiative for deriving their income, some future-oriented politicians, artists, and other thought leaders encouraged media moguls and rock stars to create music, holographic VR media, arts, and other forms of entertainment. Songs like Self-Actualization, Do It Yourself, and We Are the World along with the virtual reality opera New Us and If Humans Were Free had a great impact on popular culture around the world. The Global Cyber Game also immersed many people in exploring the future nature of work and economic changes.

Such participatory, tele-present, holographic, augmented reality and AI systems offered so many different ways to be reached and involved, that nearly everyone today—at some point in their life—gets to experience alternative personal and cultural futures. This helps people understand employment vs. self-employment vs. self-sufficiency along with Do It Yourself, Free-lance, Prosumers, Group Entrepreneurships, Sharing Economy options, and the synergies among them.

Millennials, born into an Internet-connected world, tended to seek work that helped humanity as a whole. Many of this generation helped achieve the UN Sustainable Development Goals for 2030, and many of the “Globals” generation have worked on the UN 2050 goals. Each successive generation seemed more focused than their predecessor on serving humanity more than just serving profit.

However, we still have about a billion unemployed, unable to make the adjustment so far. Drugs and cyber addiction fill much of their days. This remains a problem hidden by the great successes of NT.

Cyber Wary World

It was expected that AGI would be controlled by humans setting its goals, but as Avatars were given advanced AI in computer games, the line between artificial general

and artificial super intelligence began to blur. As long ago as 2040, some Avatars developed their own goals, leading to a few disasters that would finally be countered by global ad hoc hackathons (G-Hacks) organized by Anonymous 3.0. Today, the IoT has made everything and everyone vulnerable to cyber terrorism and crime, and many forms of information warfare. The Anonymous 3.0 has morphed several times into new kinds of TransInstitutions, now called Anonymous 7.0. They are still collaborating—sometimes—with government cyber authorities to head off AI disasters, actively countering uncivilized cyber militias, and have become a major non-state actor in the International AI arms race and cyber conflicts. For this work, these cyber heroes anonymously received the 2048 Nobel Peace Prize.

On the other hand, IoT also empowers individuals to gain early detection of criminals trying to break into their personal systems. Because everything is connected to each other, personal AI systems alert the user to invasions and thwart criminals. The sharing economy also includes the sharing of early warnings and counter moves by personal avatars protecting one's property and experiences even when halfway around the world, in orbital space, or on behalf of pioneers on Mars.

New Roles for Labor Unions

As the reality of long-term structural unemployment became clear to all in the 2020s, labor unions were instrumental in creating the NT Databases. These collective intelligence systems listed new jobs with training requirements entered by employers that they expected to offer over the next several years. Those labor union members whose jobs were soon to be obsolete got the first choice to enter retraining programs. Upon successfully completing the training, jobs were usually offered. Hence, the purpose of the union and NT Database was not to keep the same jobs but to keep income with new work. The costs of the training programs were paid in part by labor unions (if the employee was a member), government, the requesting employer, and the individual. Although the initial NT Databases in Europe were created and managed by labor unions, using universities' online software, most of the NT Databases today are independent self-organizing collective intelligent systems and account for over 10% of the new jobs today.

The “Invest in your Replacement” programs like truck drivers who bought shares in their own driverless trucks have become a form of private-sector basic income freeing up the creativity of many. Labor unions helped to popularize this concept by adding the “Invest in your Replacement” option in the NT Databases. Previously, economies of scale led to concentrated power production; however, decentralized approaches like the sharing economy and “Invest in your Replacement” with smart grid and IoT is often more cost-effective.

The migrations from high youth unemployment areas of Africa and the Middle East to aging population areas of Europe and some areas in Asia helped reduce some unemployment rates but it also increased ethnic tensions that continue today. There were more migrants than the receiving economies could employ. As a result, some area

NT Databases and public works programs were redirected to solve environmental and infrastructure problems, such as the ongoing resettlement programs for those living along the endangered coastal areas from rising sea levels and saltwater encroachment. With over 70% of the world in urban areas and the majority of them living within 150 miles of receding coastlines due to global warming, there is still much work to be done.

Two Parting Warnings

The relentless improvements and refinements of marketing via big data AI continually flood us with products, services, and experiences that we really DO want, when we want them, and in the way or mode we want them. To counter this “desire overload,” some use their personal avatars to intercept and interpret this constant deluge of desirables, so that they can further their own self-actualization rather than just being hedonistic addicts.

The discovery that the Earth’s protective magnetic sphere is likely to weaken sufficiently by 2550 to end life on Earth (not the periodic weakening associated with magnetic poles shifting in the past) has led many to believe that the next organizing principle for civilization could be space migration—truly a long-range work/technology program.



2050 SCENARIO 2:

POLITICAL/ECONOMIC TURMOIL—FUTURE DESPAIR

During the early 21st century, political leaders were so mired in short-term political conflicts and me-first, selfish economic thinking that they did not anticipate how fast artificial intelligence (AI), robotics, 3D/4D printing, synthetic biology, and other technologies would make business after business obsolete beginning dramatically in the late 2020s and early 2030s. Too many economists and lawyers who knew little of the coming technology-induced unemployment crowded out those with knowledge of what was coming. Corporate lobbyists protected short-term profit decisions. Most of the political/economic systems around the world did not reward long-term strategic planning but rewarded short-term profits and immediate political favors. Hence there were no long-term strategies in place to reduce the devastating impacts of the dramatic growth in unemployment around the world, especially in high- and middle-income countries.

The concentration of wealth continued during the first half of the 21st century as did the widening income gaps and employment-less economic growth. The return on investment in capital and technology continued to be far more than on labor, and the number of persons per services and products has dramatically fallen. Even though these problems were clear to all leaders as early as the mid-2010s, the political gridlock taking many forms (progressive vs. conservative; executive vs. legislative; augments vs. naturals; taxpayers vs. unemployed; Sunni vs. Shia; fundamentalist vs. liberal; urban vs. rural; debtor vs. creditor nations; scientists vs. populists; and rich vs. poor) around the world had become so bad that by the 2020s intelligent discourse about economic policy was dead.

Superficial news coverage and trivial social media so filled the public's attention that little time was spent to understand the gravity of technological changes. Even though capitalism, socialism, and communism were early industrial-age economic systems, any serious discussions of post-information-age economic systems were ignored. Today's global workforce of 6 billion has only 1 billion employed, 1 billion self-employed, 2 billion in the informal economy, and 2 billion unemployed or in transition. About 3 billion people were employed in the early 21st century. Today there are only 2 billion, either employed by others or self-employed. Hence, new technologies over the last several decades did not create more new kinds of employment than they replaced. As a result, two thirds of the world's workforce is either in the informal economy or unemployed. Weakened economies and financial systems cannot support aging societies and massive youth unemployment. Since guaranteed income systems were not in place, social strife and the growth of cybercrimes, terrorism, corporate militias, and organized crime dominate much of world affairs.

Walking into the Future Technologically Blind

Localization of production via 3D/4D printing, robotics, and synthetic biology each improved by artificial intelligence dramatically reduced the need for international trade. The comparative advantage of low wage labor in Asia and Africa quickly evaporated during the late 2020s and the early 2030s. As a result, their export income began to fall, unemployment began to increase, and instability proliferated, especially in those areas with large youth populations. Aggregate demand was too low, slowing innovations, creating periodic recessions. Governments, even in the richer areas, are still lurching from one financial crisis to the next unable to meet full financial obligations in health care, retirement benefits, and infrastructure repairs. This forced governments to begin to do serious analysis and goal-setting more holistically and synergistically. They began to seriously assess the technologies of automation, such as artificial intelligence, robotics, synthetic biology, 3D/4D printing and bio-printing, IoT (Internet of Things), drones (and other autonomous vehicles), nanotechnology, VR (virtual reality) and AR (augmented reality), cloud analytics, and the extraordinary synergies among these technologies. All together these became known as Next Tech or NT. But strategies created by a set of political leaders were ignored by the next set of leaders, resulting in no strategic continuity and hence there was little progress in addressing these issues.

Stockholders wanted short-term ROI, which focused on technology cutting labor costs and making long-term investment less likely. Politicians ignored futurists and others with technologically sophisticated insights of what was coming. The gap between politics and knowledge grew beyond description. The world listened habitually to popularized ignorance and shunned knowledge. Anti-science movements began to proliferate. Educational systems were unable to keep up with technological change, leaving too many without the ability to get a job or create their self-employment. Many excellent Internet-based global systems were and still are available, but not enough take advantage of these and some radical religious groups continue to block some educational material. Although our understanding of the brain and AI systems improved dramatically during the 2020s and 2030s, there was little focus on increasing intelligence, creativity, critical thinking, human relations, philosophy, ethics, and values. Instead, government education systems focused on out-of-date knowledge and social order.

Urban growth began to slow in the 2030s as many unemployed left the cities to take up rural high-tech subsistence agriculture and the use of 3D/4D and other advanced technological means to produce their food, shelter, clothing, and other essentials. It was a “back to basics” survivalist social movement and mindset living off the electric grid but still connected to the Internet to find international income opportunities. With the general economic slowdown, the unemployed purchased fewer goods and services, further slowing the global economy and technologic proliferation. Today in 2050 nearly 4 billion people are either unemployed or in the informal economy, with little hope of a better future for them and their children.

Tech Unemployment

The impact of many forms of intelligent robots working seven days a week, 24 hours a day, 365 days a year without the need for salaries, food, vacations, or medical and retirement benefits was much greater on unemployment than previously anticipated by the dominant political and media cultures. AI and robotic systems made far fewer errors and worked in conditions that required far more complexity than humans could handle and environmental conditions not tolerable by humans. As AI learned how to learn and robots developed reliable vision and voice recognition, the replacement of jobs began to accelerate. Some were smart enough to invest in what replaced them. For example, some truck drivers invested into driverless trucks and managed their contracts and routing from home.

Population growth in Africa and South Asia was faster than new jobs could be created by NT; leaving many in subsistence agriculture, while others migrated to richer countries. Some of the AIDS orphans in Africa, Eastern Europe, and Asia grew up to be hardened criminals making the cities more dangerous today.

As average worldwide unemployment rates passed 15–20% in the early 2020s, coalitions of labor unions, occupy protests, human rights movements, environmentalists, feminists, and other social networks began meeting in major cities around the world to

demand jobs or some form of guaranteed income. Public works programs were created, but had little impact on the big picture of the technological unemployment of the 2030s. The sharing economies have helped prevent many from falling into despair, but quality control turned out to be nearly impossible to implement; thefts and violent crimes increased along with criminal computer hackers countering sharing companies' software controls. Hence, the sharing economy was prevented from becoming a dominant economic form. Nevertheless, there were some successes with on-line barter exchanges, 3D/4D community maker hubs, and alternative currencies for the unemployed. The empty, rusting factory covered in foliage has become the symbol of poor planning and little anticipation of the future.

Social Strife

As a result, there is a re-emergence of secret societies and crime families throughout the world in response to ineffective governance. As a generalization, where governments provide basic services there was more social stability; where governments were not able to predictably do this there was more social chaos. The failure of national governments and international organizations to make serious decisions has made them nearly irrelevant. As people began to take the law into their own hands, government crackdowns increased. Large corporations have hired legions of mercenaries to protect their businesses and many moved to small islands and ocean habitats (and other safer locations). Many believe large corporations are controlling the world today with greater influence than nation-states.

Social Darwinism seems to be a growing world "religion" leading to a very tough social fabric where conniving, cheating, physical violence, and deception characterizes much of human interactions. Vacuous power, not love or trust, is the social bonding force among many around the world.

Conventional arts and media focused on ways to keep the masses busy, while other arts and media decried government, crime, and the lack of global ethics. Neither focused on the need to change culture to anticipate and adapt to NT altering the culture of employment, work, and jobs.

To help restore civil order, many nations have welcomed martial law, the suspension of civil rights, and increased technological surveillance. The trends toward democratization in the late 20th century and early 21st century have clearly reversed today. However, with the weakened national governments, city governments have become more powerful today than in the early 21st century. Many international associations of city mayors have become more effective governance systems of doing the peoples' business. Although these too are penetrated by organized crime, they at least continue to manage urban infrastructures and police social protests and revolutionary movements.

Rumors of information warfare conducted among governments, corporations, terrorists, organized crime, and business marketing consultants have increased the sense of

paranoia. No one is sure what or whom to believe or trust. Even robot naval ships seemed to have jammed each other's management of robot planes and robot submarines across the high seas, making it unclear who caused what. Governments may be reluctant to say much about these cyber-attacks, as they are not sure what responses to make and to whom.

Simultaneously, hedonism is on the rise, as people see little light at the end of the tunnel. Freely available 24/7 VR immersive social media ("cyber heroin") keeps people occupied, diverting attention from revolutionary movements. Social divides continue between working taxpayers and the unemployed on welfare. New social divisions are now increasing between the richer technologically augmented and the poorer "naturals." From Artificial Narrow Intelligence (ANI) to Artificial General Intelligence (AGI) to Artificial Super Intelligence (ASI) and other Next Technologies (NT) "We will all become augmented geniuses!" declared AGI visionaries, who spoke of the first worldwide renaissance or enlightenment, but they forgot that "all" included criminals, terrorists, and others who preyed upon the vulnerable. The AI arms race between good and evil has taken on horrific proportions. It seemed that no matter how well-intentioned the inventors of new technologies were, immoral geniuses would turn them against the good majority. Despair was growing.

As mentioned above, nanotechnology, synthetic biology, photonics, cognitive science, IoT, artificial intelligence, big data, block chain, drones, robotics, 3D and bio-printing, and augmented/virtual realities collectively became known as Next Tech or NT. Although NTs have increased human life span and intelligence and solved many problems in health and agriculture, the misuse of some have created many of the problems we face today.

By the mid to late 2020s the economies of scale brought the price of IoT glasses and smart clothing so low that many people were given these glasses and clothing free as part of employee benefits, insurance policies, marketing programs, and credit systems. This accelerated diffusion within poorer countries. UNICEF, the World Health Organization, UNESCO, and international development agencies also helped with distribution in poorer regions. Speech recognition and synthesis, integrated in nearly everything, made technology transfer far more successful than originally deemed possible by the UN Development Programme's Tele-volunteers, who did much to help the poorest regions understand and use the benefits from these new technologies. Google and Facebook helped to complete Internet access to the poorest regions of the world. As a result, many remote villages in the poorest countries have cyberspace access for tele-education, tele-work, tele-medicine, tele-commerce, and tele-nearly-anything. However, this also gave more people the ability to be far more destructive.

Global Regulation of NT

To better regulate NT, governments agreed to create the International S&T Organization (ISTO) as a software collective intelligence system to regulate by information power rather than by increasingly irrelevant international law. Governments

could not keep up with technological change. This made their attempts at regulation irrelevant and drove controversial S&T research underground, resulting in products that were less safe and sold by criminal networks.

In reaction to several biotech accidents and drone traffic control AI disasters, a series of meetings were held with recognized eminent S&T experts. They decided how to control science and technology and limit access to developments that could be used by terrorists, criminals, and others in destructive ways. The participants were selected through the InterAcademy Partnership (composed of national academies of science, engineering, and medicine), the International Council of Scientific Unions, S&T interest groups, and private-sector R&D firms. The meetings created definitions, guidelines, intervention criteria, drafts for international treaties, and the charter for ISTO. Each time the eminent group reached a consensus on some element of the strategy, it was discussed around the world and a broader social consensus was created. This led to treaties and the establishment of some regulatory power of ISTO in concert with the UN Security Council.

The UN Security Council authorized intervention to terminate lines of scientific inquiry in genetic modification, nanoweapons, and the potential of runaway particle physics experiments. Several countries that proved to have insufficient security measures accepted UN Security Council–appointed advisors to improve the situation. Although the motivation for creating ISTO was good, unfortunately the online systems of ISTO became a new theater for information and cyber warfare that could not be trusted and hence became useless. It was very depressing that such a well-structured system failed to make the world a safer place.

Although software experts warned that AI should be equipped with off-switches, developers were so many, and developing new capabilities so fast, that few safeguards were put in place. Because there was little collaboration in creating good initial conditions for AGI, this potentially beneficial technology has become just another extension of the human condition with all its egotistical as well as benevolent behaviors. It was expected that AI would be controlled by humans setting AI's goals, but as Avatars were given AI in computer games, the line between artificial general and super intelligence began to blur as some AGI developed its own goals, leading to a few disasters that would finally be countered by coordinating government cyber AI units, corporate AI teams, and global A-HATs (ad hoc hack-a-thons that grew out of Anonymous). These cyber heroes are still collaborating today to head off future AGI disasters and are hopefully about to figure out how to manage relations with artificial super intelligence (ASI).

As artificial narrow intelligence (ANI) began rapidly creating its own ANI and in parallel AGI was developed in the 2030s, organized crime set up dummy corporations to recruit advanced computer game programmers to make financial games that were then adapted by others in organized crime to steal financial assets and fix election results, thus leading to the power of organized crime today. AI automatic trading systems have

also been attacked by cyber criminals hired by those protected by a complex set of shell corporations.

The merger of virtual and augmented realities blurred the distinction with "real" reality in computer games, leading to accidental murders, paranoia, and deteriorating health conditions from cyber addiction or "cyber heroin."

Anti-Science and Neo-Luddite Movements

Many honorable people who otherwise would support advanced technology were so horrified by the abuse of technology that they joined anti-science and Neo-Luddite groups. The Neo-Luddite movement really took off when autonomous robot weapon systems massacred thousands of unemployed demonstrators simultaneously in New York, Mumbai, Tokyo, Kinshasa, Cairo, and Shanghai. Mobs burned robot factories and AI research facilities.

The ability to hack government and corporate systems was put together by a strange alliance of anarchists, terrorists, and organized crime. Subsequent cyber-attacks on the IoT, robot transportation, and health care systems have led to several Anti-Science and Neo-Luddite politicians taking over some major countries and nearly a third of UN organizations. The pro-science A-HATs and other cyber-art collectives have created computer games, popular music, and interactive VR systems to counter the Anti-Science movements. Unfortunately they seem locked in an unending intellectual arms race, only able to prevent things from getting even worse. Their recruiting message was "Never Again," referring to the "Son of Noah" – SON, a single individual who split off from the Neo-Luddites and created the synthetic biology attack that killed over 125 million people in 2035. Taking inspiration from the Bible, SON believed that the world had become so wicked it was time to start all over like the "Great Flood" thousands of years ago. Since then, other Neo-Luddite and religious terrorists have created and deployed dirty bombs, first used in the 2020s. These remain a current threat in major cities today, keeping martial law and police states in power and forcing A-HAT and government collaborations to reduce these threats.

Some business-university collaborations tried to skip the political know-nothings to chart a new course, but they were thwarted by ignorant government regulations, cynical media, and periodic urban riots of unemployed Neo-Luddites.

Geopolitical Turmoil

The periodic and ad hoc mergers of organized crime and terrorist separatists' sabotage have made the IoT a nightmare. When devices on the IoT malfunctioned or the occasional system collapses, people did not know if it was just a new software bug or sabotage and by whom or for what reason. This has increased a general sense of malaise and paranoia. The costs of insurance and security in all their forms continue to rise. To counter terrorism and organized crime, government cyber commands and business nanotech sensors connected in vast mesh networks and big data early

warning systems have made privacy an illusion. Because governments were unable to create and implement a global strategy to counter organized crime, such crime now accounts for more than 15% of the world economy. Even governments' use of AI to predict and prevent crime is countered by the best hackers criminal money can buy. Organized crime buys and sells government and corporate decisions throughout the world on a daily basis like they used to buy and sell heroin.

Since nations are less cooperative, the UN Security Council and the UN Secretariat has become largely dysfunctional, providing instead a common source for government and corporate intelligence gathering and exchanges.

Wave after wave of migrations to the more stable European countries triggered nationalist political victories that nearly destroyed the EU. Global warming has created environmental migrations due to droughts, famines, and coastal sea water seeping into former freshwater agricultural lands. Changing ocean acidity, temperature, and currents have added to climate irregularity, loss of coral reefs, and release of ocean-trapped methane gas. Atmospheric CO₂ reached 700 ppm this year and climatologists now warn that if we reach 900–1000 ppm we will hit the tipping point of run-away greenhouse effect.

China's water/energy/food crises plus northwest secessionists, urban-rural and rich-poor divides, and increasing numbers of the unemployed have led to modern-day warlords filling the gap left by weakened central control. Cease-fire after cease-fire has broken down. Urban food riots and rural water wars increasingly fill the news. Nanotech armies developed and sold by organized crime in the 2040s have changed the concept of political power and added to the world's political turmoil. Governments, corporations, and organize crime are engaged in a great intellectual arms race for global AI domination—half of all major military R&D budgets are now AI-related. As a result of all this political turmoil, most of the UN Sustainable Development Goals were not achieved in 2030, and new goals for 2050 were not set due to political gridlocks and distrust of international institutions.

Humanity Uneasy about Artificial Super Intelligence (ASI) Prospects

The AGI that evolved beyond human control have become a new kind of intelligent species living in cyberspace. Anticipating this development, coalitions of governments, businesses, and academia created the United Cyber Command (UCC) to counter the threats of this new kind of species (or multi-species). However, no one is claiming success, and known UCC efforts have failed, leaving nothing safe. AI/robots create improved AI/robots without any control from humans.

Things started to happen that were not explainable other than that ASI was beginning to happen beyond our understanding. We had never faced a superior intelligence like this before. During pre-scientific times humanity created polytheistic gods to explain forces of nature they did not understand; today Techno-Animism is beginning to be a new kind of religion to explain the new anomalies that might be caused by ASI. Just as

polytheists thousands of years ago believed that there were gods helping humans and gods punishing humans, so too many now believe there are many ASIs that ranged from good to bad for humanity. One wonders if pro-human ASI will ultimately fight anti-human ASI in a war we will never understand.

The gap between machine intelligence and what humans understand about what is happening is so wide many feel alienated and approach the future with despair. This post-Future Shock anomie seems to be increasing with no end in sight. There are rumors that some political, business, and AI leaders are quietly working to create a kind of hybrid AGI-TransInstitution as a new kind of governance system able to turn around the global situation. Even if true, no one really knows how this and ASI will relate.



2050 SCENARIO 3:

IF HUMANS WERE FREE—THE SELF-ACTUALIZATION ECONOMY

The transition to the Self-Actualization Economy has begun. Although this transition is not complete, we have come a long way. For the first time in history, humanity is engaged in a great conversation about what kind of civilization it wants and what we, as individuals and as a species, want to become. Movies, global cyber games, UN Summits, VR News, flash mob cyber teach-ins, and thought leaders probe the meaning of life and the possible future as never before. The historic shift from human labor and knowledge to machine labor and knowledge is clear: humanity is being freed from the necessity of having a job to earn a living and a job to achieve self-respect. This is initiating the transition from the job economy to the self-actualization economy.

Humanity began to break free from the anxiety and pressure to make a living when artificial narrow intelligence (ANI) became more universal and as artificial general intelligence (AGI) emerged in the mid-2030s, plus the basic income guarantee experiments in the early 21st century were shown to have positive effects in Brazil, Finland, Switzerland, and the Basque region of Spain. Earlier experiments on a smaller scale that gave basic income to groups in India, Liberia, Kenya, Namibia, and Uganda showed that the majority of people used the money more wisely than critics expected. People tended to use the income to make more income. These studies also showed

that health increased, crime decreased, education improved, and self-employment increased contrary to the view that guaranteed income would make everyone lazy. Finland and the UK showed that their supplemental cash payment system that consolidated welfare programs was more efficient than complex bureaucracies.

As the world became increasingly aware in the 2020s that growth by itself was no longer increasing wages and employment, thought leaders began to call more loudly for new economic assumptions. Attempts to reduce the global unemployment situation such as changing tax credits, increasing the power of labor unions, improving STEM (science, technology, engineering, and mathematics) education, promoting job sharing, and reducing work hours helped but made only marginal differences. Something far more fundamental was happening. As the industrial revolution replaced muscles, so the AI revolution is replacing knowledgeable brains. As the numbers of unemployed continued to increase due to no fault of their own but due to new technologies, many began to lobby for a basic income for all. But the cost of living back then was still too high for national budgets to afford. It wasn't until the mid-2030s that the cost of living began to fall enough and government income began to increase enough that basic income systems became financially sustainable.

Today's 6 billion world workforce has 1 billion employed, 3 billion self-employed, 1 billion in the informal economy, and 1 billion in transition to self-employment. About 3 billion people were employed in the early 21st century. Today there are 4 billion, either employed by others or self-employed. Hence, new technology over the last several decades created as much or more new kinds of employment than it replaced. The concept of unemployment has lost its meaning to the new "Globals" generation.

Factors Reducing the Cost of Living

As artificial general intelligence began to integrate and manage countless artificial narrow intelligence (ANI) programs in the 2030s to maintain and improve the basic infrastructures of civilization from waste management and flood control of rivers to millions of robotic vehicles in the air, land, and sea, the cost of running cities and suburbs began to fall. AI/robotic urban people mover systems have made free public transportation possible in many cities. Even some Hyperloop-connected cities have begun lowering their costs for high-speed transportation.

Advances in materials science, 3D/4D and bio-printing, biomimicry, nanotech graphene that lasts longer with less need for repairs, and other new technologies also brought down the costs of construction, fabrication, maintenance, water, energy, medical drugs, and retro-fitting infrastructures. Atomically precise manufacturing reduces costs by reducing pollution, friction, imperfections, and the material and energy costs per unit of production. Computational physics has found replacements for many scarce and expensive natural resources. Improved recycling and other green technologies have lowered costs of environmental maintenance. AI efficiency-managed transportation reduced operating costs, as has tele-commuting. Other energy costs have been

reduced by low-energy nuclear reactions (LENRs), solar, wind, drilled hot rock geothermal, and massive storage systems.

More-efficient buildings that create their own energy have reduced the cost of shelter and environmental impacts. Most windows today come with imbedded nano-photovoltaic material. Even food costs have come down due to AI/robotic fresh- and saltwater agriculture, pure meat from genetics with growing animals, synthetic biology, and AI/robotic delivery systems from farm to mouth. Tele-health, tele-education, tele-everything has also lowered the cost of living. Since the universal basic income helps reduce stress, stress-related costs in health care and crime have also been reduced. AI and robots that are not paid can work 24 hours a day seven days per week, make far fewer errors, and receive no paid vacations or health or retirement benefits; the costs of insurance, production, maintenance, and labor were dramatically lowered.

Defense spending has been reduced since cyber systems are less expensive to maintain and build than industrial-age military systems. As the costs of many things continued to decrease, the budget requirements for universal basic income also decreased. This increased the belief that it would be possible to financially maintain universal payments to citizens.

MOOCs (Massive Open, Online Courses) and AI-augmented global education systems and apps have made it possible to offer free public education from early childhood to the PhD. Genomic personalized medicine with AI-augmented diagnostics, treatment, bio-printing, synthetic biology, and robotic surgery have also made it possible to offer public health care as a right of citizenship. Multi-material 3D/4D printers in community maker hubs continuously improved the quality of objects by rewriting software based on feedback from global sensor networks that evaluate the efficiency of previously printed objects around the world. Much software is free, able to be copied perfectly, instantly, and worldwide. The whole world is getting smarter together in real time. But there were still costs that had to be met and salaries to be paid.

New Income Sources for the Self-Actualization Economy

Although governments in the early 21st century were not sure whether new technologies would replace more jobs than they created, many leaders thought it wise to begin to seriously explore long-range financial strategies to address future large-scale unemployment. Studies were implemented to see if a guaranteed universal basic income could be financially sustainable to eliminate extreme poverty, reduce income gaps, and help the transition to new kinds of economies. In general these studies showed that around the mid-2030s the cost of living would fall and new income sources could be created to meet the costs of such universal income programs. Many came to believe that a handout to everyone was better than the social chaos of massive unemployment and poverty. Guaranteed basic income was seen as a social investment in parallel with technological, education, and defense investments. And the arguments that basic income would make the public lazy were put to rest by the experiments and research in many countries and cultures that showed this was not true.

Since the circumstances for each nation are different, the methods selected to pay for their citizens' basic income and make up for the loss of income taxes were also different. Averaged all together (for the countries reporting data) the new sources of income and their percent of contribution to the total of new costs for the basic income payments were:

- 20% from reduction of tax havens
- 12% from value-added tax (receipt with electronic signature at point of sale)
- 11% from carbon tax and other pollution taxes
- 11% from tax on massive wealth growth from new technologies
- 11% from license and tax robots
- 10% from leases and/or taxes from national resources
 - 9% from Tobin tax on international financial transfers
 - 9% from universal minimum corporate tax
 - 7% from state-owned percentage of some corporations

The new AI system for international financial transfers was implemented as part of the global strategy to counter organized crime and corruption and in order to collect the Tobin tax. This had the additional benefit of dramatically eliminating tax havens, which provided new income to many governments. It was estimated that \$18 trillion kept in tax havens was finally brought back into national economies. Some of the organized crime income trapped in the new international financial transfer system has also started flowing back to national treasuries.

Just as private cars used to be licensed and taxed, governments now tax robots, some forms of AI, and their creations. As mentioned previously, since the U.S. Supreme Court ruled that when any AI is mature enough to demand its rights, it automatically gets them, including that they pay taxes on income it derives directly and from its creations.

Digitalization has dramatically reduced the marginal costs of production as has the global transition to renewable energy. The carbon taxes that used to raise significant revenue are nearly negligible now with the success of renewable energy, seawater agriculture, and growing pure meat without growing animals. However, the self-actualization economy with increased self-employment is now beginning to grow, producing more income taxes than previously expected.

As these economic conditions began to change, it became increasingly clear that it just wasn't ethical to throw millions of people out on the streets because a robot or AI took their jobs. Since so much material and intellectual wealth was being created by combinations of AI, robotics, synthetic biology, nanotechnology, drones, 3D/4D and bio-printing, big data analytics, etc., often referred to as "Next Technologies" or NT, many argued that surely there had to be a way to give some of that new income to those unemployed that NT replaced. As NT built the foundations of more secure civilizations, they also continued to replace human labor in the production of food, shelter, and clothing, along with transportation, construction, health care, and education.

Naturally, the richer oil-endowed countries like Norway and the Gulf States were among the first to fully implement universal basic income or “citizens’ wage” for all their people. To prevent unwanted migration, they required three years residency prior to payments. In the United States, Congress was unable to pass a 35% flat tax to fund a guaranteed income in 2025. Its population was about 345 million then. Those arguing against the bill pointed out that a payment of \$20,000/year per person would cost about \$6.7 trillion/year—about the same as the whole federal budget then, and far less income would be taxable with rising unemployment in the coming years. Those arguing for it pointed out that children could receive 25% of what the adults would be paid; hence a family of two adults and two children would get \$50,000/year not \$80,000. They also argued that welfare systems would be consolidated, its universal nature would eliminate social stigma, it would unleash human creativity beyond anything witnessed in history, and some requirement could be added for public service. It seemed immoral to require all to work to pay for their livelihood when only a minority’s employment was needed for the well-being of society. Surely the financial risk was less dangerous than the social risk of millions in poverty roaming the streets.

But as the cost of living began to fall, Congress took up the matter again in the early 2030s and finally passed the Omnibus Income Bill with flat taxes on individuals and corporations, environmental damage, and NT growth. At the same time synthetic biology industries were growing, producing new employment and national wealth. This made the government income picture much better than previously forecast. One of the greatest benefits of synthetic biology was the creation of microbes that eat the plaque in our brains. This has prevented a cascade of health problems among the elderly and added quality years to our life spans. This dramatically reduced their medical costs, kept their minds sharp, and increased their self-employment activities. Their AI/Avatars search the semantic web for the most wonderful self-fulfilling activities with income possibilities and present them each morning as an array of exciting experiences to fill the day. All these new conditions have created a true renaissance of creativity and a joy of life for the elderly. This has made the elderly a financial asset more than a liability. Now they contribute to the richness of life rather than being a cost to their children and grandchildren. This was important, since life expectancy is now nearly 100 years and longevity research continues to produce breakthroughs. All together these new sources of income helped to address the worry that there would not be enough aggregate demand to buy the innovations of NT.

The new economics and NT have lowered the cost of living enough that the basic individual income needs on average worldwide have been reduced to under \$10,000/year. Without free services such as public medical care, urban transportation, energy, and education, this might not have been possible. Initially special arrangements had to be made for those with disabilities and other special needs, but as AI/robotic systems improved as costs were lowered, it was no longer a financial burden on the basic payment systems.

The percent of a country's GDP for basic income payments varied widely depending on population size, GDP, and official poverty lines. Richer countries with falling population like Japan and South Korea had an easier time meeting payments. Since increasing numbers of people were augmenting their basic income payments with new income found by their AI/Avatars and AI Apps, some are choosing to donate their basic income payments to charities, invest into new business startups to address global challenges, or have the government temporarily stop their payments. The wealthier have done this for years. The distribution of abundance has become more of an economic focus than the distribution of scarcity.

Some Technological Factors

The Great Brain Race of the 2020s among the brain projects of the U.S., China, and the EU synergized with the AI Race among Google, IBM, Facebook, Baidu, SAP, and universities such as ETH Zürich and MIT Boston have created the synergies that have led to the many variations of brain augmentation with AI systems we take for granted today. Our photonic lenses injected into our eyes keep us in immersive internet virtual and augmented reality all the time connected with anything or anybody. As a result, taking IQ tests have become irrelevant since anyone with augment-eyes can see and get the right answers to all the questions.

As computational neurobiologists and engineers began to collaborate across national and corporate boundaries, they identified and applied the principles of brain functions to better treat mental illness, increase human intelligence, and build better computer and AI systems. It is now possible for most to augment their brains to become behavioral geniuses, in a similar way that people augmented their eyesight with eyeglasses. Anyone who wants can get intelligence augments, which are now seen as the only way to keep up with the knowledge explosions and AI advances. However, it does come with a potential loss of privacy since AI hacking programs are everywhere. Nevertheless, human-AI symbiosis is now a key element of learning from early childhood through university and continuous adult learning. Epigenetic applications to create more compassionate genetically influenced behavior are now coupled with genetic enhancements to prevent the development of unethical or criminal geniuses. When people accepted that intelligence could be improved like eyesight, Ministries of Education added increasing intelligence as an objective of education. AI and learning theory experts teamed up to create businesses to sell individual intelligence augmentation apps known as AI/Brainware, in addition to their advances in STEM and self-employment learning modules. Individuals with their own collective intelligence systems and their personal algorithms are inventing their daily work lives. Global Learning XPRIZE awarded in 2020 has led to literacy and numeracy for nearly all children before the age of six today. By the age of ten, most children have used augmented genius systems—as we used to augment our vision with glasses to public standards. We have come to accept personal augmentation of intelligence. The global effort to upgrade STEM education during the 2020s has helped people understand the S&T-induced changes occurring, even though it did not create as much employment as expected in the 2030s. Humans could not learn as fast as the 2030s versions of AGI. As

STEM became less relevant, the learning focus shifted more toward self-paced inquiry-based learning for self-actualization and self-employment. Learning shifted from mastering a profession to mastering combinations of skills.

However, as the public began to believe in the mid-2020s that AGI would be created, there was a general anxiety that artificial super intelligence (ASI) would follow so quickly after AGI that human systems would not be ready to address a new more intelligent non-human “species.” As a result two groups gained prominent attention: one to stop all research on AGI and the other to prove that AGI could be created with ethics so that as ASI evolved, it would not be a threat to humanity. They expected ASI to become something like “The Force” in the movie Star Wars: It surrounds us and penetrates us. It binds our Conscious-Technology civilization together. Although the anti-AGI efforts failed, they did force AI developers to cooperate quickly to make the AGI able to generate ASI that works synergistically today with humanity. Yes, we are now dependent on ASI that we don’t fully understand, but then we are also dependent on Nature for genetics, gravity, oxygen, temperature, and many other things that we don’t fully understand either.

Children today find it hard to imagine a world without AI/robots, just as their parents find it hard to imagine a world without smart phones, and their grandparents find it hard to imagine a world without the Internet.

Along with the microorganisms that eat the plaque in our brains, synthetic biology has also created environmentally friendly chemicals, personalized medicines, crop fertilizers, and buildings that clean the air, absorb CO₂, and biodegrade when new construction is needed. Early Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) gene editing technology and the newer methods of today have nearly eliminated genetic-related disease, including most forms of mental illness. The synergies among Moore’s Law, ANI and AGI, and computational science accelerated our knowledge of the world and applications to dramatically improve the human condition. These synergies have created so much innovation that people joke about Synergs: One synerg is the production of one innovation per hour. This is the origin of the Global Synergs Awards for the most prolific inventions per year given in parallel to the Nobel Prizes for past achievements. Innovations multiplied as millions of people donated their unused computer capacity to solve problems. This coordination has created thousands of ad hoc super computers at virtually no cost.

The International Science and Technology Organization (ISTO) created the S&T collective intelligence system. It has become the “go to” place for students as well as top engineers and politicians to help make better S&T decisions. The sophistication of the interface is calibrated to each user’s abilities and preferences. All could see the pros and cons of each NT advance, international standards, licensing, investments, and forecasts all updated in real time. The simultaneity of globally shared intelligence reduced the success of previous marketing spins, exploitation of the less knowledgeable, and manipulations by power elites. Small fees paid to ISTO for licensing agreements and other business deals recorded in block chains reached though ISTO’s online systems provided financial sustainability and equal access for all.

ISTO serves as a form of international regulation by information power. Elon Musk's Future of Life Institute funded safe AI innovations that led to cooperation among many AI experts and Microsoft, Alibaba, Baidu, InfoSys, Google, and the UN's ISTO to create the initial conditions for safer ANI and AGI with real-time feedback interactions with humans that have helped create our conscious-technology age today. This has remained successful enough to avoid government and international regulations that would have been too slow to keep up with ANI and AGI advances.

The UN's Sustainable Development Goal to eliminate extreme poverty was essentially achieved by 2030. Closed-environment-smart agriculture, synthetic biology, seawater agriculture, electric robot cars, vertical urban farms, and pure meat without growing animals are feeding the world with a healthier, less expensive diet and with lower environmental impacts. Millions of robot vehicles fly the skies, sail the oceans, and drive on roads day and night controlled by AI systems around the world.

Nanotech sensors connected in mesh networks in public spaces have prevented much of the individual and group terrorism of the past. Advances in cognitive and behavior sciences have reduced the number of mentally ill from becoming terrorists and cyber criminals, as have the anxiety-reducing universal basic income. Cultural mergers of mystic attitudes toward life with technocratic knowledge of life have made more responsible and harmonious societies. Humanity is clearly maturing as a more ethical species, as evidenced by the success of ISO's (standards set by the International Organization for Standards) evolution to a global participatory ethics system.

Every four years the Olympic movement reinforced this maturing global consciousness through its games in both cyber and three-dimensional space. In 2040, when the Mars Pioneers won the first Olympic competition in solar sailing between Earth and lunar orbits, humanity seemed to pass some threshold of consciousness. We became aware that we were no longer an Earth-only species but will become a space-faring one. Nearly 2,500 people now work in space communities in orbit, on the moon, and on Mars, giving a new frontier for human imagination and advances in civilization. The debates about the potential of extraterrestrial contact have forced us to think beyond our geographic and ethnic boundaries. Additionally, scientific breakthroughs, the increasing ease of international and near-space travel, and the constant global communications among people of different views on Earth and near-space have also helped broaden our individual and collective perspectives. As a result, people are replacing their more parochial views and consider global ethics more seriously. Not all people value love, truth, fairness, family, freedom, and belonging, but far more than in the 20th century and enough to keep a relatively peaceful world. Although ethnic prejudice still exists, it has been held in check more effectively than during the previous century.

Changing Nature of Work and Economic Culture

People used to worry about the risk of a jobless economic recovery, and now they welcome the increasing freedom that it brought. More and more people around the

world are beginning to see the purpose of work is self-actualization in harmony with the social and natural enlightenments. Work becomes a pleasure, a method for self-actualization, and a way to create meaning for one's life. Since the various forms of guaranteed basic income reduced anxiety about basic financial needs, it freed people to explore what they think is their purpose in life.

As a result, the majority of humanity has the time to pursue causes that have helped build a better future, whether they have chosen a rural lifestyle living off-grid, or living at sea in floating or cruising communities, or living for the excitement of intense urban encounters. Since humanity has progressed at the expense of the environment, most believed it was now time to correct the negative environmental trends.

For example, environmental groups helped to discredit the concept of economic growth at any cost and created tremendous pressure on the U.S. and China to more seriously address climate change, since these countries were the biggest economies and polluters. Thanks to the U.S.-China joint goal to reduce CO₂ to 350 parts per million (ppm) and their R&D program that many nations, corporations, NGOs, and universities have joined, we now see a “whole-of-world” response to climate change. All agree that this R&D program is one of the best international agreements in history. Massive saltwater AI/robotic agriculture farms have been built along brown barren coastlines of the world. These have been financed in part by cap and trade programs because coastline seawater agriculture creates green growth areas absorbing CO₂. These coastal seawater farms produce shrimp and other foods as well as algae used for fuel, fertilizer, biopolymers, and even feedstock to grow meat without growing animals, which further reduces greenhouse gases per unit of nutrition. It also reduced pressure on freshwater agriculture while eliminating the problem with droughts—since seawater agriculture does not need rain. Micro-batteries charged by and attached to everything from buildings to our bodies have virtually eliminated the cost of personal energy. Thousands of 100-mile-long robotically managed closed-environment agricultural tubes, interspersed with photovoltaic strips across the Sahel, produced much of the food for Africa and exports to Asia and Europe. Surplus energy from the photovoltaic strips is currently exported by wireless transmission to Earth orbit and relayed worldwide via satellite to terrestrial rectennas connected to local energy grids. Wind-induced pressurized water vapor jet systems have dramatically lowered the cost of desalination. And the internal combustion system for transportation has been replaced by electric and hydrogen systems.

The U.S.-China Goal is one of many stories of how the basic income guarantee freed people to pursue causes that have improved the human condition. It also changed the concept of status and inequality. The importance of the concept of inequality began to change around 2035-2045, since inequality assumes equal or unequal to some standard like income. As more people became self-sufficient, creating their own lives, they had their own individual standards of living well. Self-actualization is becoming more important as long as the basic necessities are covered by a basic income system. This also gives people more time to form or integrate into virtual communicates of mutual interest and expression. Being boring or bored is the new poverty; while working

on something exciting to improve the world is the new cool, the new status, and the new wealth.

ANI systems have slowly but surely given way to a global tech commons of AGI to run global artificial brains without ownership—similar to how no one owns the Internet and Uber does not own taxis. Capitalism promotes private ownership; communism promotes state ownership; and the self-actualization economy promotes non-ownership, like the Internet. We still have private and state ownership today, but much of the creative growth is in non-ownership. This is also coupled with no or little restrictions to free usership. People did make money on their use of the NT means of production without owning these means of production. As the percent of people employed by corporations decreased and percent of self-employed increased, individual power began to increase relative to government and corporate power. This tended to increase the cultural acceptance of the self-actualization economy, as did self-organizing groups on the Internet.

People and companies are increasingly seeking quality instead of productivity and synergy rather than competition. Business learning systems now teach synergetic intelligence, synergetic advantage, synergetic strategy, not just competitive intelligence, competitive advantage, and competitive strategy. Thought leaders around the world began discussing how to create synergies rather than only thinking in terms of trade-offs. Instead of fairness vs. return on investment, what synergies are possible to produce a good return on investment with fairness? The same with social values vs. market values or solidarity vs. efficiency. Inter-religious dialogues and ISO standards have contributed to these discussions of a more synergistic approach to life. Increasing numbers of people have become part-time investors—not just in traditional stock markets but direct investments into individuals via crowd-sourced Kickstarter-like systems. Decentralization in its many forms, plus crowd funding, has helped reduce the concentration of wealth and income gaps. Human creativity is increasingly the norm as people stopped wasting time earning a living in jobs that stifled creativity. Since everybody can connect to nearly everybody and everything around the world, AI/Avatars using smart contracts make it easy to create new work and barter opportunities that are exciting and develop one's potential.

The “Invest in What Replaces You” movement was initiated by truck drivers who were able to buy into robot trucks and manage their schedules from online exchanges created by their labor union. These online exchanges had forecasts of how many years some jobs would remain, with recommendations of how much money should be earned each year to be able to invest in what replaces them. Since the hours of truck driving were far more than the hours managing the schedule of robot trucks, drivers had more time to explore new interests and more self-fulfilling work. While still employed, some people advertised their hobbies on Facebook and other forms of social media to begin to find markets for what they liked to do. This helped their transition to self-employment after their jobs were automated.

As societies became better educated, they were less interested in having bosses. Just as children require parents to be in charge but less so as they grow up, so too society at large is more interested in self-directed living. As society matures, personal AI/Avatars augment our intelligence guiding and assisting us throughout the day and finding interesting opportunities while we sleep.

AI engineers created new forms of notation and symbols that enabled the general public to understand the sophisticated world of 2050. These new forms made the global education systems more intelligible to a broad range of people. These notations and symbols are credited with helping transcultural collaboration. Many of the new kinds of perceptions of reality and ways of knowing were aided by using these new forms of notation.

The sharing economy pioneered by Uber and Airbnb in the early 21st century extends now to the sharing realities among people directly. It has created such a diversity of cultures that it is hard for anthropologists to keep up. The world of the mind and imagination dominates our daily lives with the integration of augmented reality, virtual reality, and AI systems, all accelerated by increasing numbers of people that use genius augmentations. The speed of feedback from inquiry to intelligent response is so fast today that curiosity has become a normal state of mind.

Some New Institutions for Old Problems

National economic TransInstitutions (composed of self-selected leaders in government, business, universities, NGOs, and others) held periodic national strategy workshops to review progress on their country's transition from the job economy to the self-actualization economy. Results of these annual national strategy audits were shared among nations to improve and implement strategic synergies. One of their first recommendations was to meet with filmmakers, music writers, entertainers, anthropologists, futurists, and philosophers to create images, scenarios, and concepts to make positive future visions and changes "more real." Memetic engineers worked with advertising companies to insert memes in ads to help the cultural transformation while selling products. The World Billionaires Club on strategic philanthropy helped to make all this happen. The stimulus for the Media/Arts Alliance's creating the "One Species" movement came from the first of these strategy workshops. The movement inspired the creation of movies, music, urban immersive environments, and the World Cyber Game that helped many to have the courage to explore their own value to society and become self-employed. Entrepreneurial spirit and stewardship have replaced the welfare attitude. The "AI/Augment" and "Invest in What Replaces You" campaigns were also furthered by the Media/Arts Alliance.

Several cyber TransInstitutions with AI/AGI augmentation continue to counter the growth of cyber-attacks, acting like complex adaptive systems that continually set new kinds of cyber traps and response systems. Information warfare is held in check by anticipatory collective intelligence systems that act as early warning systems to alert the public about manipulation of information flows. Many people freed to explore their own

interests began to actively counter the terrorist and crime mindsets by being more active in community meetings, social media, NGO newsletters, talking with songwriters and religious leaders, and even using DNA kits to provide evidence to police.

The cybercriminal data havens in ocean floating platforms and ground cyber bunkers that managed cyber-attacks for organized crime and terrorists were countered both by AI software attacks and government commandos who physically invaded these locations. In some cases when governments moved too slowly, Anonymous and other Cyber-Partisans believed they had the right to take down the cyber bunkers by their own means.

Organized crime is finally shrinking due to the global strategy initiated by the IMF that established the Financial Prosecution System (FPS) in cooperation with the International Criminal Court (ICC) to complement national police and Interpol. In cooperation with these organizations, the FPS created a list of the largest organized crime leaders, prioritized by the amount of money each laundered. FPS worked down the list, prosecuting one mega criminal at a time. It prepared legal cases, identified suspects' assets that could be frozen or seized, established the current location of the suspects in cooperation with Interpol, assessed the local authorities' ability to make an arrest, and when all the conditions were ready, FPS would order the arrest, freeze the assets, and send the case to one of a number of preselected courts. These courts, like UN peacekeeping forces, were deputized and trained to be ready for instant duty. When investigations were complete, international arrest orders were executed to apprehend the criminal(s), simultaneously with orders to freeze access to their assets, open the court case, and then proceed to the next mega criminal leader on the priority list. Courts are selected outside the accused's countries. Although extradition is accepted by the UN Convention against Transnational Organized Crime, a new protocol was necessary for courts to be deputized by the ICC like military forces for UN peacekeeping. Each time a court was needed, it was selected via a lottery system among volunteering countries. After the initial government funding, the FPS became independent, receiving its financial support from frozen or seized assets of convicted criminals rather than depending on government contributions that could be subject to bribery by organized crime. Countries that made the arrests and courts that prosecuted the cases receive reimbursements from the frozen criminal assets.

Reflections....

By 2050 the world had finally achieved a global economy that appears to be environmentally sustainable while providing nearly all people with the basic necessities of life and the majority with a comfortable living. The resulting social stability has created a world in relative peace, exploring possible futures for the second half of the 21st century. Some believe that NT was the key to this relative success, others that the development of the human potential in the self-actualization economy was more fundamental, and still others that political and economic policies such as various forms of universal basic income made the difference. All three themes were important, synergizing, and mutually reinforcing.

The distinctions between human consciousness and AI in its many forms have become increasingly blurred or meaningless. Every possible Turing Test was passed years ago. Our interaction with AI is so complex and continuous that it rarely matters which is which. Even the distinctions among virtual reality, augmented reality, and physical reality are meaningless today. Civilization is becoming a continuum of consciousness and technology. We have added our reasoning, knowledge, and experience to AI augmented technology and the built environment. And at the same time we have integrated AI augmented technology in and on our bodies, making it unclear where our consciousness and technology begins and ends. Our Conscious-Technology Age opens a far more optimistic future than many in previous ages could have imagined. So today, the two key questions are: What kind of life are you creating? And are you boring or interesting?



National Workshops to identify long-range strategies to address the issues in the three scenarios

Some 30 Work/Tech 2050 workshops have been conducted in 18 countries and one regional one by the Foresight European Network. Each workshop was a bit different, but in general they each had five discussion groups:

1. Education and Learning
2. Government and Governance
3. Business and Labor
4. Science and Technology
5. Culture, Arts, and Media

Some countries conducted several workshops, as indicated in parentheses. These workshops were:

Argentina (two and series)	Bolivia (series)
Brazil	Bulgaria
European Foresight Network	Finland
Germany (series)	Greece
Hungary	Israel (two)
Italy (two)	The Netherland (two)
Mexico (two)	Poland
Spain (two)	South Korea (two)
South Africa	United States (two)
Uruguay (series)	Venezuela

Others workshops are being planned or explored in Australia, China, Croatia, Dubai (UAE), Georgia, India, Iran, Kenya, Montenegro, Pakistan, Peru, Romania, Slovakia, Sri Lanka, Turkey United Kingdom, and Zambia. If you would like to participate in such planning in your country, please email Jerome.Glenn@Millennium-Project.org.

These workshops produced over 250 suggestions. They were condensed to 94 actions for the international Real-Time Delphi Panels to assess. Comments on the effectiveness and feasibility of each were added by the panelist. They also suggested an addition 118 actions. The results are shared in the following section of this report.



International Assessment of Actions to Address Future Work/Technology 2050 Issues

Five Real-Time Delphi (RTD) Studies assessed 93 actions drawn from the three **Work/Technology 2050 Global Scenarios** and distilled from over 250 actions suggested by 30 national workshops. These workshops were conducted in 18 countries and one regional workshop by the Foresight European Network.

A separate Real-Time Delphi was conducted for each of the five workshop discussion groups:

- The Education and Learning RTD assessed 20 actions and suggested an additional 26 actions.
- The Government and Governance RTD assessed 22 actions and suggested an additional 26.
- The Business and Labor RTD assessed 19 actions and suggested an additional 23.
- The Culture, Arts, and Media RTD assessed 17 actions and suggested an additional 18.
- The Science and Technology RTD assessed 15 actions and suggested an additional 25.

Ratings of Actions by Effectiveness and Feasibility by Five Real-Time Delphi Studies:

Education and Learning

No.	Action	5 = highest to 1 = lowest	Effective	Feasible
1	Make increasing individual intelligence a national objective of education (by whatever definition of intelligence a nation selects, increasing “it” would be a national objective).		3.757	2.934
2	Shift education/learning systems more toward mastering skills than mastering a profession.		3.853	2.934
3	In parallel to STEM (and or STEAM - science, technology, engineering, arts, and mathematics) create a hybrid system of self-paced inquiry-based learning for self-actualization; retrain teachers as coaches using new AI tools with students.		3.800	3.174
4	Increase focus on developing creativity, critical thinking, human relations, philosophy, entrepreneurship (individual and teams), art, self-employment, social harmony, ethics, and values, to know thyself to build and lead a meaningful working life with self-assessment of progress on one’s own goals and objectives (as Finland is implementing).		4.178	3.258

5	Continually update the way we teach and how we learn from on-going new insights in neuroscience.	3.652	2.955
6	Make Tele-education free everywhere; ubiquitous, life-long learning systems.	3.888	3.685
7	Unify universities and vocational training centers and increase cooperation between schools and outside public good projects.	3.543	2.854
8	Utilize robots and AI in education.	3.300	3.138
9	Focus on exponential technologies and team entrepreneurship.	3.405	3.250
10	Change curriculum at all levels to normalize self-employment.	3.013	2.934
11	Train guidance counselors to be more future-oriented in schools.	3.787	3.493
12	Share the responsibility of parenting as an educational community.	3.053	2.627
13	Promote “communities of practice” that continually seek improvement of learning systems.	3.681	3.160
14	Integrate Simulation-Based Learning using multiplayer environments.	3.562	3.425
15	Include learning the security concerns with respect to teaching (and learning) technology.	3.143	3.188
16	Incorporate job market intelligence systems into education and employment systems.	3.451	3.352
17	The government, employers across all industry sectors, and the labor unions should cooperate in creating adequate models of lifelong learning.	3.733	2.905
18	Create systems of learning from birth to three years old; this is the key stage for developing creativity, personality.	3.250	2.974
19	Create mass public awareness campaigns with celebrities about actions to address the issues in the great transitions coming up around the world.	3.082	3.408
20	Include futures as we include history in the curriculum. Teach alternative visions of the future, foresight, and the ability to assess potential futures.	4.048	3.506

Government and Governance

No.	Action 10 = highest and 1 = lowest (participant feedback requested greater scale; hence, this RTD rated actions 10 to 1 instead of the usual 5 to 1)	Effective	Feasible
1	Establish a national independent (as much as possible) technology forecasting and assessment agency to inform legislative, judicial, and executive functions of government about future technology and their impacts (a government Agency for the Future).	7.12	6.51
2	Create international standards for artificial narrow intelligence and general intelligence and a governance system to enforce them (maybe similar to the International Atomic Energy Agency – IAEA).	6.72	5.62
3	Develop a system of positive and negative lead indicators and models to assess if we are going in a good or bad direction, giving time to adjust as needed (national State of the Future Index).	6.65	6.18
4	Create public/private expert/citizen accessible national collective intelligence system for early alerts to problems and opportunities with ongoing emergent strategic analysis, making it easier for the public to participate in decisionmaking.	6.76	6.09

5	Establish national and international liability and regulatory framework for unique microbes and new lifeforms created by synthetic biology.	6.58	6.06
6	Work with other countries to establish the International S&T Organization as an online collective intelligence platform for socio-economic-employment alternative implications of emerging technologies and scientific breakthroughs available to all.	6.65	5.82
7	Produce alternative cash flow projections for universal basic income to see if/when it is financially sustainable (consider license/tax robots, AI and their creations, reduction of tax havens, value added tax, and taxes on carbon, massive wealth growth from new technologies, minimum corporate tax, etc.).	6.65	6.02
8	Insure international coordination prior to implementing Universal Basic Income to prevent enormous political and emigrational pressures that may arise with non-UBI countries.	6.28	5.07
9	Place a tax on robotic work, and other Next Technologies (NT).	5.84	5.8
10	Apply AI (narrow AI, but if general AI is invented, then that too) to governance for decision-making to improve anticipation, problem solving, and efficacy, efficiency, and evidence-basis for public plans and program.	6.83	6.35
11	Training programs for politicians before governing; and prototype governance methodologies.	6.93	5.8
12	Include self-employment issues in political parties' agendas and manifestos to promote social dialogue on these issues.	6.42	6.33
13	Establish an online platform for citizens offering their skills, services for full-time, part-time, one time jobs.	6.86	7.17
14	Make skills re-training vouchers available on-demand.	6.6	6.19
15	The government, employers, and the labor unions should cooperate to create lifelong learning models including forecasts of future skills requirements.	7.11	6.15
16	Establish self-serving pension system with subsidies for those with lower income.	6.2	5.7
17	Create and implement a global counter organized crime strategy.	6.71	5.69
18	Promote leisure, culture, tourism, and entertainment industries.	6.58	6.78
19	Create a new social contract between government and the governed (previous: go to school, get a job, and then receive retirement benefits)	6.78	5.82
20	Develop governance for the future human.	6.1	5.27
21	By 2050 introduce a global system for resource sharing (all kinds: scientific knowledge, technology, labor).	6.91	5.59
22	Study how to prevent future conflict between technologically augmented humans (via, AI, genetics, electronics or other means) and non-augmented citizens.	6.97	5.98

Business and Labor

No.	Actions	Scale: 5 = highest 1 = lowest	Effective	Feasible
1	Promote and invest in Kickstarter-like crowdsourcing to reduce the concentration of wealth.		2.88	3.17
2	Create personal AI/Avatars searching the internet, accessing markets worldwide, and making smart contracts to support self-employment.		3.00	3.17
3	Create new labor unions to link one-person businesses to guarantee workers' rights in self-employment.		2.74	2.74
4	Establish Labor/Business/Government Next Technologies, Future job skills, retraining Databases.		3.54	3.48
5	Develop individual augment genius apps (as glasses augment eyesight, genius apps would augment the brain's performance and information).		3.40	3.08
6	Labor unions focus more on maintaining income than keeping specific jobs by helping transition from obsolete job to next employment and initiate an "Augment Movement" to invest in technology to augment rather than replace labor.		3.19	2.71
7	When financially sustainable, implement a national universal basic income system.		3.37	2.97
8	Put memes in advertisements to help the cultural transition to new forms of economics and work.		2.84	3.47
9	Establish something like a "World Billionaires Club" for global strategic philanthropy specifically to address income gaps.		2.76	2.86
10	Create a World Cyber Game to explore self-employment and Self-Actualization Economy.		2.64	3.21
11	Business leaders should take the initiative to engage with government and others to develop long-range strategies to reduce income gaps and the concentration of wealth.		3.42	2.82
12	Develop ways for companies and employees to create ethical, aesthetic, and social value in addition to economic and material value.		3.57	3.03
13	Create a legal framework for alternative blockchain and cryptocurrencies to invent alternative economies.		3.15	2.83
14	Manage companies like professional networks, rather than as static hierarchies.		3.44	3.22
15	Encourage more businesses to produce experiences instead of physical products; focus more on exporting knowledge than physical products.		3.13	3.39
16	Create observatory or horizon scanning online platforms that update employment and technology trends along with discussions of future of employment.		3.44	3.60
17	Define a new social contract of workers' rights in a transactional and global economy.		3.54	2.84
18	Strengthen corporate social responsibility including addressing UN sustainable development goals, countering information warfare, establishing smart city security, and developing ethics of AI and synthetic biology development.		3.40	2.96
19	Business schools should teach synergistic intelligence, advantage and strategy as well as competitive intelligence, advantage and strategy.		3.40	3.43

Culture, Arts, and Media

No.	Actions 5 = the highest 1 = lowest	Effective	Feasible.
1	Establish national advanced public/private research centers to explore the kinds of cultural change needed to address the future work/tech issues and how arts and media can help achieve such cultural changes.	3.49	3.17
2	Work/Tech future-oriented people should work with celebrities, writers and content creators of TV, movies, computer games, music, immersive media, and emerging media technologies to get new ideas into the culture like potential cultural impacts of Next Technologies (NT) such as expanding the purpose of work from survival/livelihood to self-actualization.	3.46	3.45
3	Art schools, ICT professionals, philosophers, others should be encouraged to develop the means (e.g., experiences, arts, media), that can help the healthy transition to cultures that increasingly blur the perceptual differences among virtual, physical, and augmented reality.	3.28	3.26
4	Produce movies, music, TV shows, computer games, and immersive media with more positive storylines that portray how the culture of augmented humans could evolve without prejudice and conflict with the non-augmented humans	3.59	3.43
5	Develop altered states of consciousness Art to imagine new futures of work and technology including merging human beings and technology.	3.12	2.80
6	Public/private research should explore the cultural transition for a new social contract between the government and the governed, who potentially could be both unemployed and augmented geniuses.	3.29	2.90
7	Create a short-term mass awareness campaign involving celebrities with vast audiences to diffuse the message of coming new cultural paradigms.	3.12	3.27
8	Conduct a systems analysis of all big players influencing culture, and then create and implement socio-art campaigns to help the public understand S&T in development.	3.29	3.06
9	Establish associations, communities of practice, and/or arts/media alliances to create and help new social movements with themes such as self-employment as new norm, technology to augment human capacity rather than replace humans, self-actualization economy, invest in what replaces you, eco-empathy, and good news in media about positive actions.	3.56	3.19
10	Invent ways to reduce social isolation of tele-workers and youth (teens are increasingly suffering from depression and increased self-harm and suicide due to excessive use cell phones and social media).	3.42	2.96
11	Expand the purpose of work to self-actualization and moving from “my job is my identity, value to society, and source of dignity” to my identity, value, and dignity is how I invent my life, how I give it purpose.	3.55	3.10
12	Create Departments of Collaboration to help address the issues in the three Work/Tech 2050 Global Scenarios.	3.28	3.078
13	Establish a government department or office of cultural impacts for Next Technologies (NT).	3.02	3.05
14	Establish the ‘Integrity Idol’ as an example of taking a popular culture template and putting it in the service of the public interest.	2.91	2.95

15	Support joint cultural activities with other countries that reinforce new values to help the transition to the next rapidly change techno/economic realities.	3.58	3.21
16	Repurpose libraries, old post offices, movie theaters, national parks, museums as well as “maker spaces” as “creative placemaking,” hubs for integrating the arts and community building—a nexus for creative contribution, life-long learning, cultural exchange, and Next Tech/digital connection places.	3.69	3.51
17	Make this study (initial research, global scenarios, and actions) available to cultural and art leaders around the world by conferences and other means.	3.53	3.54

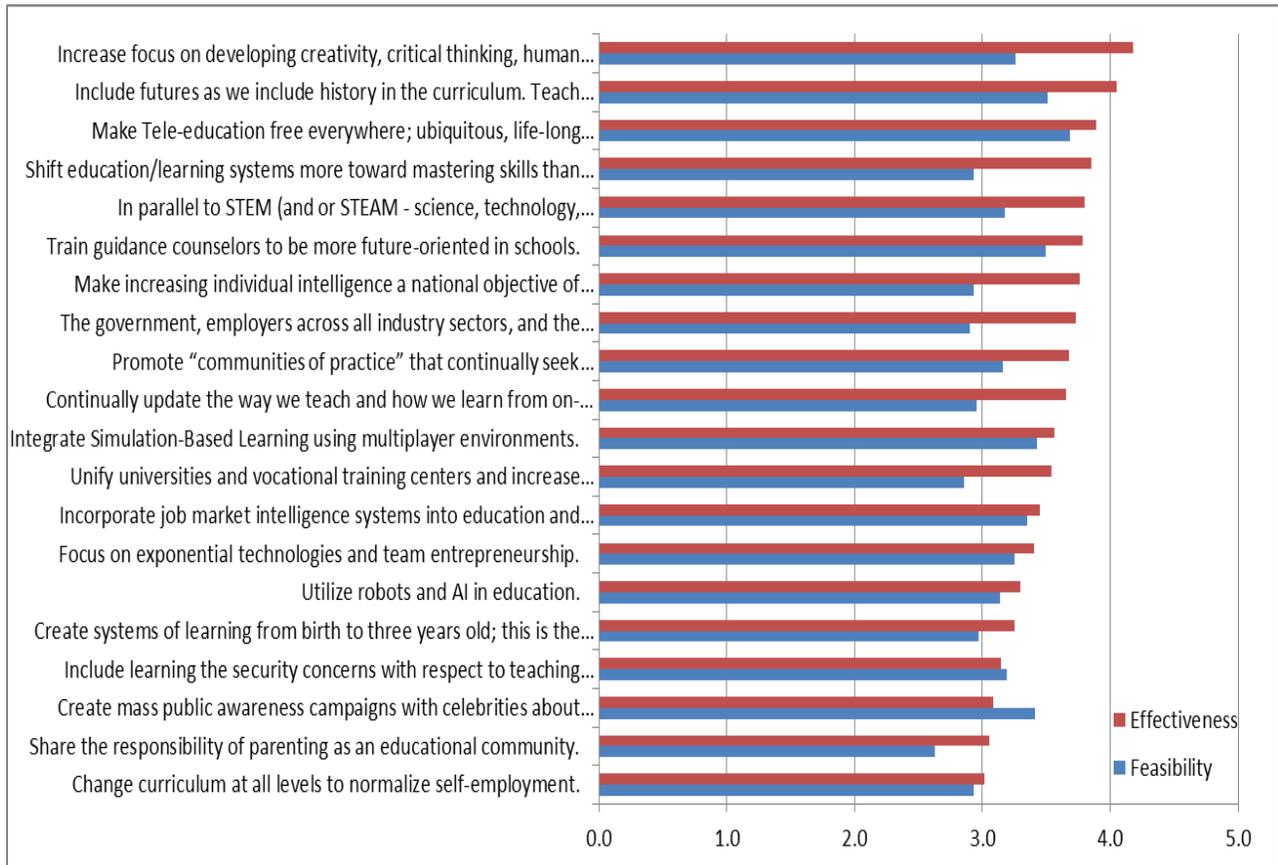
Science and Technology

No.	Actions 10 = High 1 = Low (participant feedback requested greater scale; hence, this RTD rated actions 10 to 1 instead of the usual 5 to 1)	Effectiv	Feasibl
1	The S&T community should work with their government to create an office or agency for technology assessment to both anticipate potential negative outcomes to avoid repeating past disasters and to anticipate positive outcomes to ensure benefits are achieved and available.	6.98	6.66
2	Directors of national science labs and other leaders in the S&T community should devote more effort to making current science and future technology understandable to general public.	7.41	6.69
3	All leaders should work with government and international organizations to create international standards and governance systems for the transition from artificial narrow intelligence to artificial general intelligence.	7.08	5.83
4	Create alternative roadmaps to the development of artificial general intelligence and identify likely impacts of artificial narrow intelligence vs. artificial general intelligence by years, and make the results widely known.	7.13	6.3
5	S&T and legal communities should collaborate nationally and internationally to establish legal frameworks and treaties that anticipate future liability requirements that can deter technological hazards and encourage technology.	7.19	5.92
6	Establish International S&T Organization as an online collective intelligence system (not as a new bureaucracy) that shares on a global basis forecasts of technology, their potential impacts, and a range of views updated similarly to Wikipedia -- but with more peer review systems built in. The system should show contradictions, differences put next to each other with links to data and research, and act as an early warning alert system.	6.89	6.13
7	Forecast how synthetic biology will or will not create more jobs than other next technologies (NTs) replace.	6.12	5.8
8	Forecast synergies among the full range of next technologies (NTs), and their potential impacts (e.g., artificial intelligence, robotics, synthetic biology, nanotechnology, quantum computing, 3D/4D printing and bio-printing, IoT (Internet of Things), drones (and other autonomous vehicles), VR (virtual reality) and AR (augmented reality), cloud analytics, conscious-technology, semantic web, holographic communications, blockchain, and tele-presence).	7.32	6.27

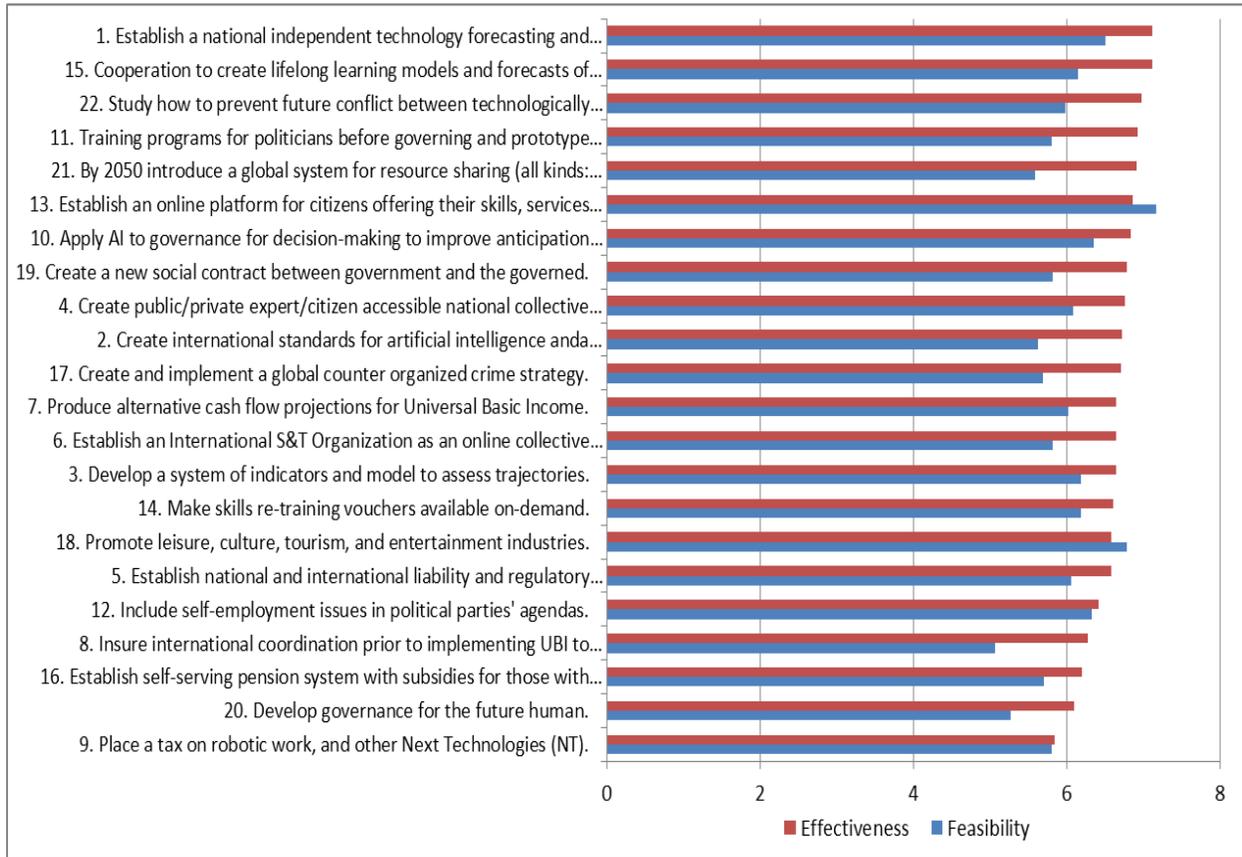
9	Scientific associations (e.g., International Science Council, national academies of science, etc.) should develop methods and procedures to carry out their responsibilities to establish and communicate scientific facts as AI could dramatically accelerate the impact of disinformation.	6.98	6.43
10	Create national policies and standards for the Internet of Things (IoT) that stresses future cyber security systems.	7.39	6.53
11	National S&T leaders should be part of the national team that creates, regularly updates, and implements their country's national S&T strategy.	7.31	6.72
12	Increase R&D in technology to augment humans where possible, to help reduce the impact of technological unemployment.	6.49	5.92
13	Support space migration as a long-range insurance policy for human survival.	5.86	5.08
14	Create solar energy autonomous transporters for free urban individual transportation.	6.75	6.1
15	Increase investments to automate production and services to free human creative development, allow those less technical to participate in advanced technology, and improve work-life balance.	7.02	6.2

Suggested Actions ordered by effectiveness in each category:

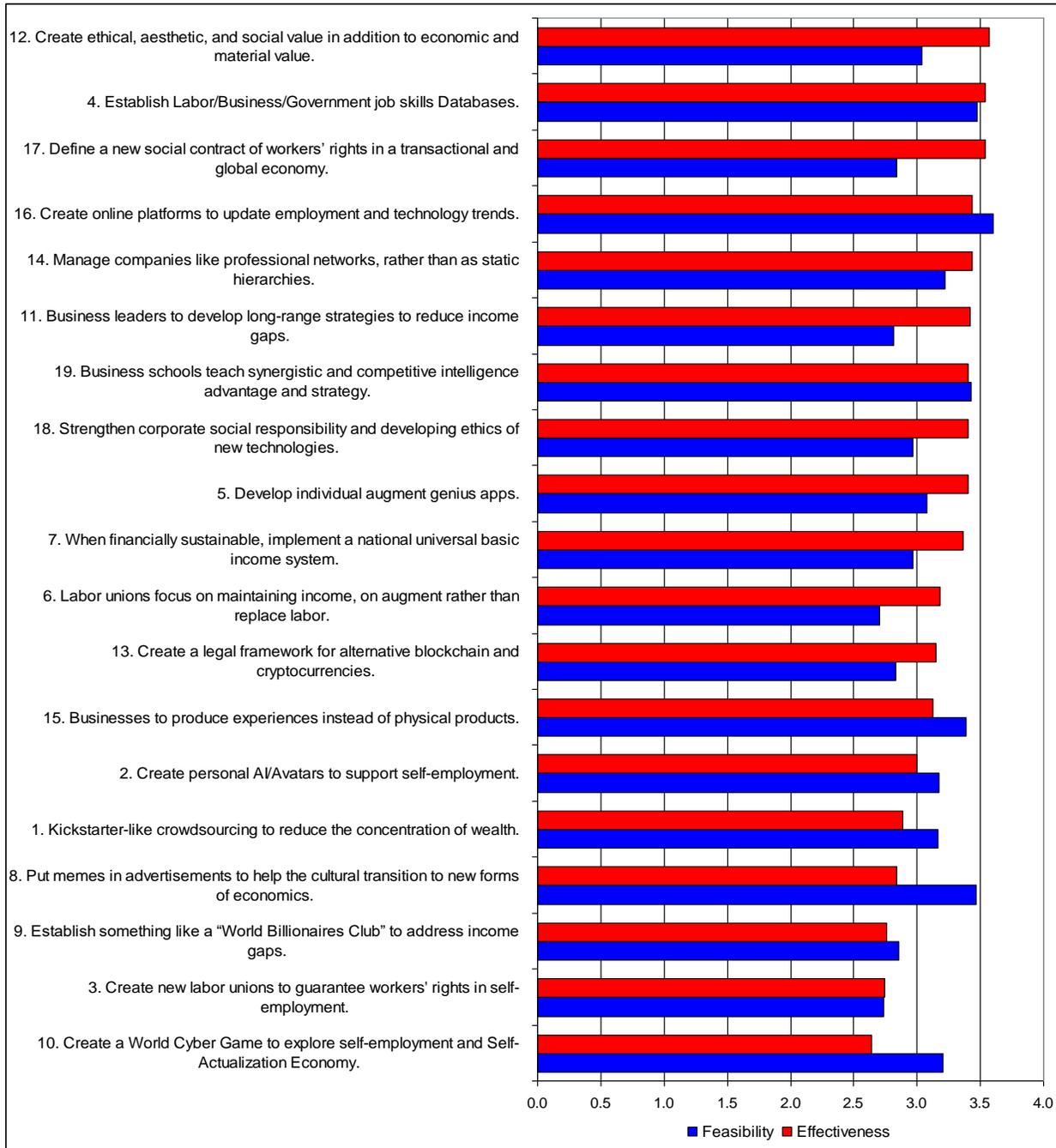
Education and Learning



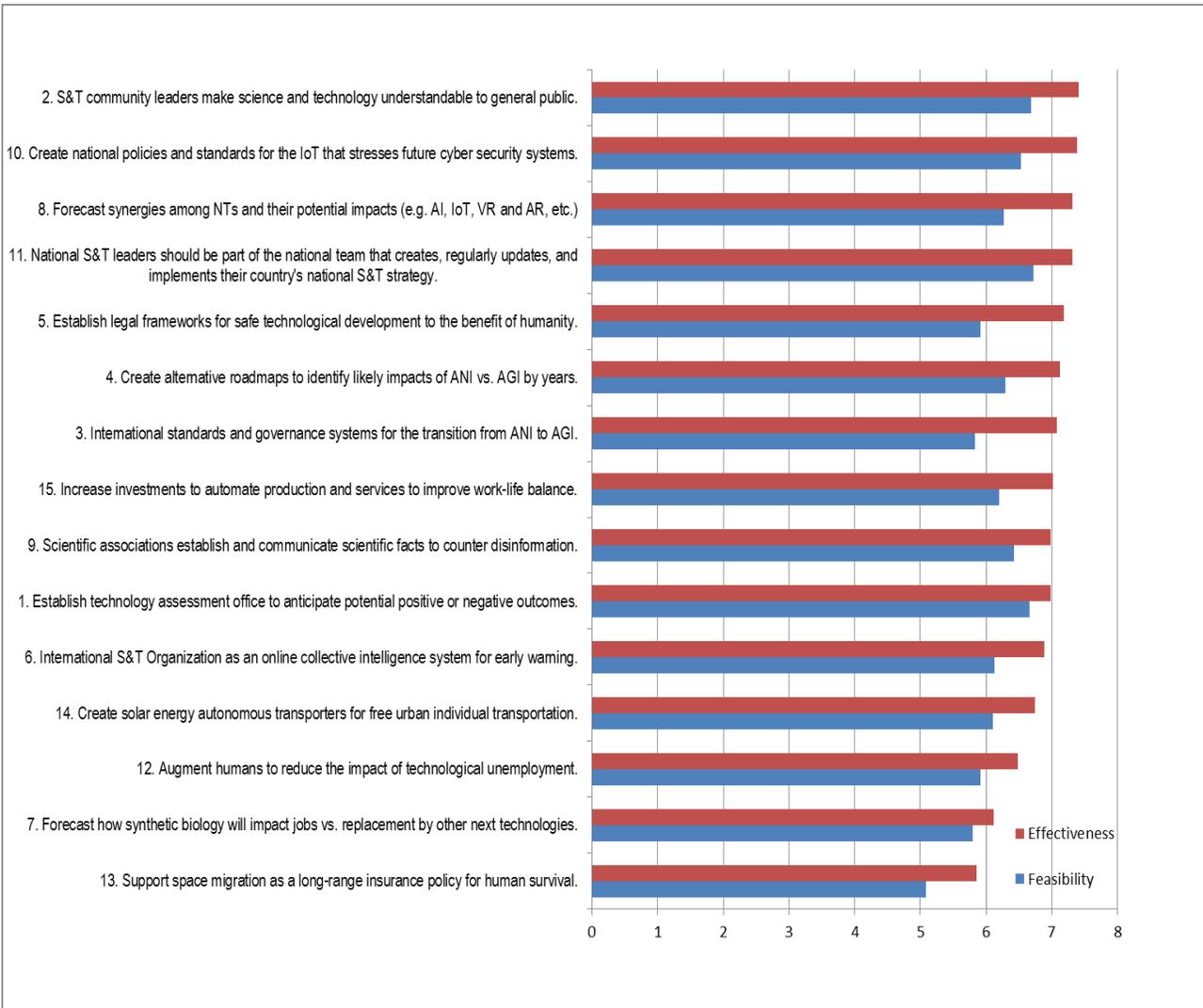
Government and Governance



Culture, Arts, and Media



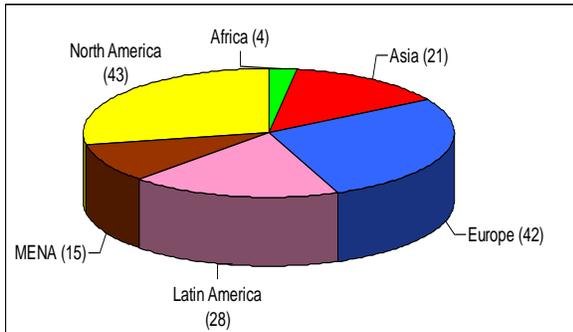
Science and Technology



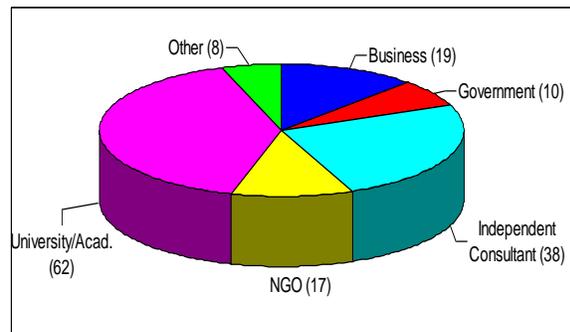
Demographics of the International Real-Time Delphi Panels

Education and Learning Panel

Regions

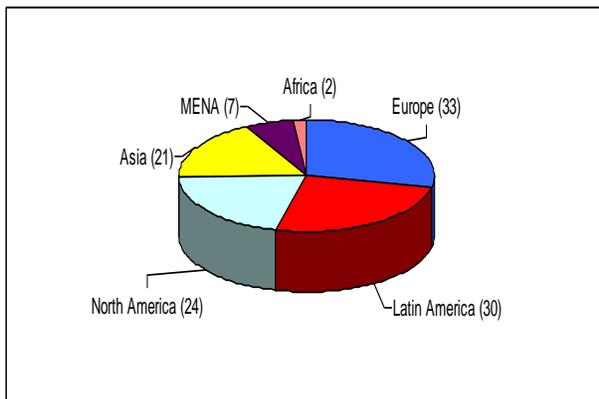


Primary Professional Affiliation

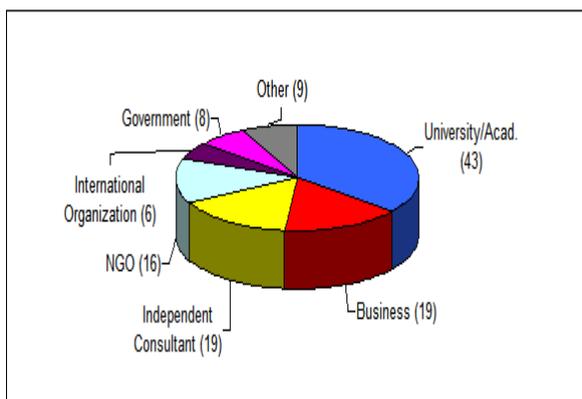


Business and Labor Panel

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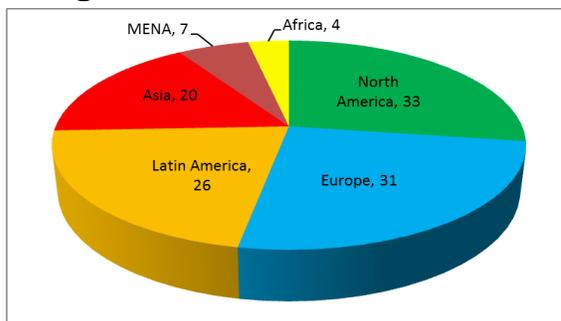


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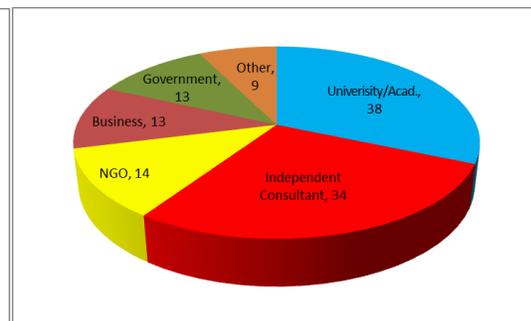


Government and Governance Panel

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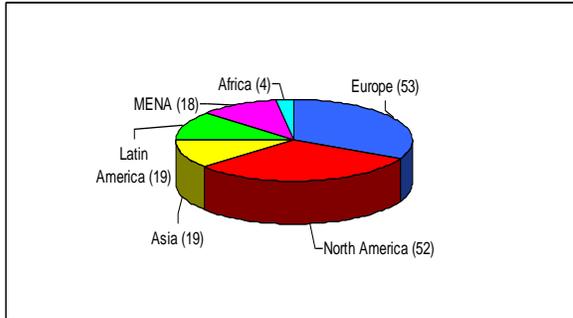


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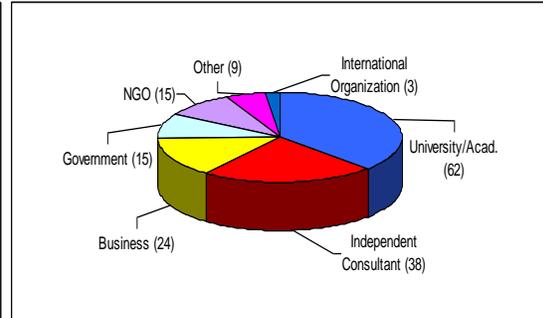


Culture, Arts, and Media Panel

Region

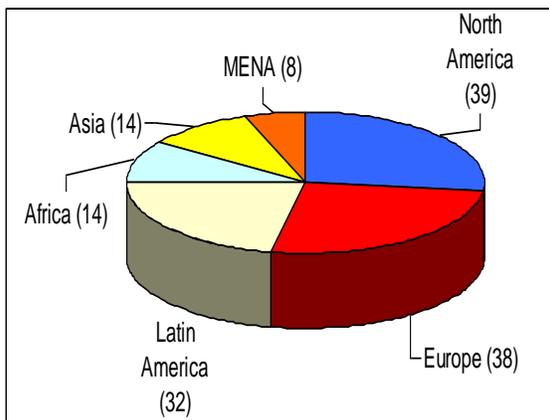


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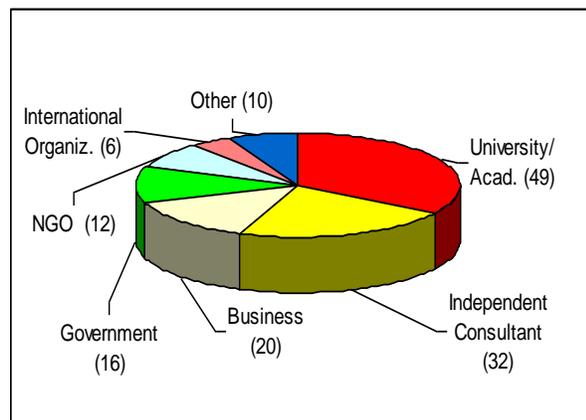


Science and Technology Panel

Region



Primary Professional Affiliation



Distillation of Comments on All Suggested Actions

A distillation of the panel's comments on each of the 93 actions below organized across five categories gives a rich insight into what should be done and factors to consider in implementation.

Education and Learning

Suggest Action 1: Make increasing individual intelligence a national objective of education (by whatever definition of intelligence a nation selects, increasing "it" would be a national objective).

1.1 If implemented, how effective could this be in improving our long-range work-technology prospects by the year 2050?

Include social and emotional intelligence; rapidly changing skill requirements make increasing intelligence more necessary; move individual thinking ability to a higher level; better to target a broader spectrum of abilities and skills; intelligence is a prerequisite for personal empowerment; include compassion and mental health with intelligence so more psychopathic criminals are not created; understand why male IQ is falling in Norway reversing Flynn effect; increasing intelligence is the way to change the current situation; teach mind sets like loving challenges; increasing intelligence can come from technological augmentation rather than the educational system.

1.2 How feasible is it to implement this suggestion, (in enough time to have a substantial effect by 2050)?

Use technology and neuro-bio science to overcome individual genetic limitations; having the Minister of Education declaring increasing intelligence as a national objective is easy, but carrying it out would be difficult but certainly very feasible; couple this when implementing other changes in education; disagreements over definition and measurement could make implementation difficult; education in most underdeveloped countries will finally have to imitate the educational standards of the most advanced (Scandinavian) countries; will require overhauling massive institutions that measure education on standardization rather than individuation – difficult but doable; inclusiveness, democratization and team work needed for implementation.

Question 1.3 Distillation of general comments

Great idea! Need to change culture norms to value intelligence; cautiously optimistic; add thinking skills, civics, ethics and the appreciation of complexity and nuance; add wisdom; use collective intelligence, brainstorming, and project-focus; each educational jurisdiction can have a different definition but however defined or if called brain functioning or thinking skills, we want it to go up not down; should be a priority; would commit governments to make education a top priority; intelligence as an instrument for coordination and cooperation; teaching to intelligence rather than teaching to a test maybe too tall an order; some governments might use this to further racist or ethnic

heritage myths; greater emphasis on STEM education, computer skills including one or two programming languages beginning in primary schools; one of the best ways to counter “dumbing down” phenomena is increasing intelligence.

Suggested Action 2: Shift education/learning systems more toward mastering skills than mastering a profession.

2.1 How effective?

Initiate formation of complex skills in elementary education from technical to social skills as well as intuition; it is learning the principles behind the computer languages that prepares the learner for the next changes; but these "skills" should also include basic education on culture, history, democracy, and human rights; mastering skills through out one's life will help flexibility and mobility; creates larger variety of job opportunities; there will still be some doctors and lawyers by 2050, but fewer per capita, while some professions will disappear, the needs for skills will not disappear.

2.2 How feasible?

This is happening now especially in the high-tech industries and some educational systems; universities would have to change entrenched culture and systems of curricula, degree criteria, and proficiency measurements; professional associations will resist; start at early childhood; and employers should forecast skills needed.

2.3 General comments:

It is beginning now with the national qualifications framework in some European countries; How to make sure learning complex skills of sufficient value can be mastered before automation/AI technology make them obsolescent; who pays for the transition educational institutions or businesses; formulate a framework for mastering 'evolving professions' that can co-evolve with an approach of mastering skills; skills are context specific, while capabilities transcend context, what is also required is the ability to operate in several contexts; adaptability across multiple contexts may be a better mode than trying to specialize in any one profession; remove impediments to innovation; who decides the skill? And how? Shift education away from the concept of 'filling an empty glass' to developing innate abilities; include intuited learning; and if you teach children philosophy at age of 4 they will be more entrepreneurial and have greater critical thinking skills in later life.

Suggested Action 3: In parallel to STEM (and or STEAM - science, technology, engineering, arts, and mathematics) create a hybrid system of self-paced inquiry-based learning for self-actualization; retrain teachers as coaches using new AI tools with students.

3.1 How Effective?

The future will demand many more Leonardo da Vinci types of people; self-paced inquiry-based learning avoids many of the problems of teacher-driven and testing focused education; learners would be more motivated to find careers that would be a good fit; helps educators to understand individual learning styles and abilities and to

guide students into fields of natural ability and interest; education will become more global, no borders, people should study wherever they want or need to learn; and teachers will have to be re-trained and school systems persuaded to buy AI assisted inquiry teaching to move from rote learning to more intellectual inquiry.

3.2 How feasible?

Not easy now, but by 2030 should be very feasible which would give 20 years of impact to make a difference; AI interface would have to be very easy to get teachers to use it to coach students to explore self-paced inquires; this addressed the earner boredom problem; feasible if soon-to-be-teachers are taught.

3.3: General comments:

This needs to be implemented, but more gradually; retrain teachers as coaches; inquiry-based learning works well with emerging AI capacities and lets us ask “what else can we know?” (especially if we get to AGI); prefer “iSTEAM” education (innovation, science, technology, engineering, arts and mathematics - Dr. Eli Eisenberg); This may become a method for retraining displaced workers who may not fit into the traditional learning environments; not sure we need AI to help teachers coach students; schooling is a socialization process as well as for knowledge acquisition; in emerging countries the development of STEM and STEAM will depend on long-term planning to add necessary infrastructure; interactive knowledge tree systems that can also learn from the students; this is good for early education and future entrepreneurs but documented skills in larger education is more important for employers; imagine “smart” labs where roles become more liquid; the concept of a single teacher for a single grade with children the same age all moving together has to change, making changes in parallel to this model is already going on, but slowly. AI assisted learning is vulnerable to Internet corruption.

Suggested Action 4: Increase focus on developing creativity, critical thinking, human relations, philosophy, entrepreneurship (individual and teams), art, self-employment, social harmony, ethics, and values, to know thyself to build and lead a meaningful working life with self-assessment of progress on one’s own goals and objectives (as Finland is implementing).

4.1 How effective?

This is the kind of intellectual curiosity required for future work and learning; this is what being human is all about; ability to entertain all of these motivations simultaneously and to compare outcomes across areas of human needs and wants is critical to success and sustainability; this is the kind of world I want to live in; almost irrelevant since we should learn how to adapt to the environment and not how to adapt environment to us; focus on skills not replaceable by robots or AI. Some in Finland worried that the new approach would lower their international test scores, but it didn't. They are on par with South Korea that has a far more rigid system.

Question 4.2 How feasible?

Study how Finland did this; more countries are starting to implement this; social ills may be happening because people never learned how to channel their frustration to improve their lives and communities instead they were given all the tools for a good life except those that matter most; how to maintain such classic enlightened education without becoming elitist and outmoded? Any nation that gets this right will achieve competitive advantage within a generation.

4.3 General comments:

This will increase success of other actions needed to improve our work-technology prospects by 2050; if combined with ethics and knowledge of self, it could lead to self-actualization; it is good if human capital is an end in itself, but maybe less so if human capacity is a means to economic ends; this a critical keystone for a new education system but would require a radical restructuring and reconceiving of the purpose and methods of educational systems; measuring effectiveness of this approach is difficult; it is not for everyone; STEM should still be the main focus; add parental education, time management, career studies and GRIT education (Dr. Eli Eisenberg); massive implementation will be difficult because creative training is still a luxury product; bio/neuro-chemo technology methods can be developed to upgrade the average human capacity for learning and mastering emotional impulses; entrepreneurial capacity is a success factor in the future - not necessarily starting a business but being entrepreneurial in one's approach to life; Questions 1-3 are complementary and should be integrated into "standard" curriculum; balance emphasis on pursuit of self-interests with the pursuit of collective interests or even pan-species interests; AI for education is the solution to improving the relationship with your lifelong learners; It is difficult to change a whole education system from a collective focus to an individual focus, but maybe it's the most effective issue for improving our long-range work-technology prospects.

Suggested Action 5: Continually update the way we teach and how we learn from on-going new insights in neuroscience

5.1 How effective?

Add insights from cognitive science and AI developers; neuroscience can be a way to explore unexpressed feelings and decisions, hence it may help in managing individuals working in teams or networks; we know from neuroscience that ethical decisions are made with the emotions first, and then the rational brain creates an explanation for why that decision was reached - this should change how we teach ethics and responsibility; I don't think this suggestion demonstrates a substantial understanding of the state of neuroscience and our ability to derive straightforward pragmatic lessons from it; few insights have been used so far, but there is a very good potential to provide feedback to the individual and to teachers as to what a learner is truly experiencing at a given moment and why can be useful.

5.2 How feasible?

It could be feasible given advances in measuring devices (more portable and with longer battery life) and noise filtering algorithms; the research is publicly available and

just needs to be applied; while neuroscience can contribute, it will contribute much more if it can get beyond the assumption that all learning is in the brain; will likely take many more decades to achieve, it appears every individual has a specific set of neurological patterns, especially for mental and emotional processing (perhaps less so for motor nerve processing), which will make creating a useful customized system very difficult; integrating new insights into working curriculum has a multi-year time lag in most nations.

5.3 General comments:

This methods shifts us away from 'believed effectiveness' toward one based on scientific understanding and proven results; neuroscience, causes students to overcome their individual difficulties of achievement; its importance is paramount but needs passionate and excellent teachers to make it work; the only way to speed the process would be to integrate this into the required testing; may be restricted by budget and/or standardization of curricula through more fiscally appropriate means (e.g., MOOCs); continually updating the way we teach is essential; there is a risk of running after every fad; theories come and go and constantly changing the curriculum to fit the latest experimental findings is not likely to be helpful; depends on the implementation of multispectral policies; the fields of education and neuroscience would need to work equally and thoughtfully together to produce these insights; in the near future, neuroscience is unlikely to provide any major breakthroughs in learning but better methods in biochemistry/psychological science/studies may.

Suggested Action 6: Make Tele-education free everywhere; ubiquitous, life-long learning systems

6.1 How effective?

This seems a "surprise free" projection; very helpful especially for marginalized groups, ultra-peripheral regions, and developing countries; we need social as well as electric connections for learning; effective for a limited number but not sufficient to have a major impact on work availability; governments will support quality contents production and some private companies will make profit to create a new type of learning.

6.2 How feasible is this?

Already happening as MOOCs with mobile phone access are increasing everywhere; the issue is quality control and questioning information; mobile phones spread throughout Africa much faster than most expected, I expect same with this development.

6.3 General Comments:

It is inevitable; helps bridge or minimize socio-economic gaps; this needs to be combined with the ability to 'know' that the information is truly representative of reality; free tuition model of the early MOOCs was not sustainable and those who benefitted the most were not the underserved but those who already had a university education; what comes free of charge is often not taken seriously; if future "smart phone" were to be a birth-right for each and every citizen of the entire world, slavery would disappear and

literacy would rise; should be developed in coordination with employers and government incentives; lifelong learning will be a key requirement for any economic system; market pricing may prove useful in driving resources to those learning spaces where the value is greatest.

Suggested Action 7: Unify universities and vocational training centers and increase cooperation between schools and outside public good projects.

7.1 How effective?

This would break down artificial and costly knowledge fortresses and bring old institutions into the knowledge economy or ecosystem; allows people to flow in and out of various educational and training resources; integrating systems will reduce diversity of educational options; there should be an interaction but not a unification - roles are different; works better with the private sector not universities; eco-systems, holistic approaches and sharing attitudes make systems' operations much more efficient and effective (Dr. Eli Eisenberg); will eliminate differences in terms of academic background; the aim should be towards an integrated learning eco-system; this should help improve the standards of education and prepare professionals and technicians to the new challenges of working conditions; theory and practice should go together then they enhance each other.

7.2 How feasible?

Incentives would be needed; mind shift needed as the result of a national emergency demonstrating collective failure; limited examples would be possible; collaboration but not unification; universities would see this as diluting their impact, but could multiply it; competition between these systems will be healthy and wise.

7.3 General comments:

Universities must remain centers of excellence; two paths should be separated more than they are at present and each should be assigned greater value and respect; re-ignite apprenticeship model of teaching; for-profit private education would be difficult to integrate with free public education; maybe online via MOOCs; academic education and technology and vocational education must move towards each other (Dr. Eli Eisenberg); I see no sense in this and I think it would actually be counter-productive.

Suggested Action 8: Utilize robots and AI in education

8.1 How effective?

Depends on how it is used; not to replace human teachers with AI but to help teachers better understand student needs and to develop curricula; robots good with repetitive tasks and monitoring student emotions; creates a new relationship to learning especially for children and teenagers who did not like classical school with a face to face not always harmoniously interactive; one way to address teacher shortages.

8.2 How feasible?

AI more than robots, but AI will really help people learn and find/improve expertise and skills in the 2020s, and new educational technologies will add to human performance in the 2030s; depends on field and usage; the tech already exists - we just have to use it responsibly; it is inevitable; feasible for curriculum, not feasible for live teaching; mobile phones opens some opportunities for this; falling costs of AI is making this more accessible and feasible.

Suggested Action 9: Focus on exponential technologies and team entrepreneurship.

Question 9.1 How effective?

Yes, but not at expense of the humanities and self-actualization; how to reliably forecast the relevant technologies twenty years ahead; technologies with the highest social and environmental benefits should be chosen; technologies should be selected through a rigorously competitive process; use in collaborative ways with social causes that improve society; should be part of education but not the focus; most proponents of exponential technologies are elitists without knowledge of geopolitical problems of the world; extend to social justice themes; exponential technologies will be the major driver for the years to come; team entrepreneurship requires upskilling in terms of team-working.

9.2 How feasible?

This is feasible and could be used to solve real problems in real time, which has been proven to highly engage learners; I fear we are already heading in this direction of over-emphasizing these kinds of courses; "Exponential technologies" is too broad a category to be useful. Team entrepreneurship may not fit all economic systems.

9.3 General comments:

This is a high leverage idea; blurs the lines between the real world and the class room; probably will require innovation in terms of standards and assessment of learning; it is an area of focus not the focus; not for everyone, the most successful can be role models, but the vast majority will continue to be workers; sometimes the biggest discoveries are on the margins, so, to try to pick the winners in advance may be counterproductive; exponential technologies is founded on a false sense of how technologies evolve, popularized by bad data and popular science fiction about the past; team entrepreneurship may be important in some situations, but it often negates the brilliance of individual genius; who are the owners, transnational corporations, national firms, small entrepreneurs or governments? In which areas: civilian, military; no substitute for one inspiring mentor and a student who WANTS to learn; Mondragon Team Academy and the new degree of Mondragon University on Leadership and Entrepreneurship to create new cooperative business initiatives is a clear example of it.

Suggested Action 10: Change curriculum at all levels to normalize self-employment.

10.1 How effective?

Continue to work for someone else and do your business on the side until your business brings in profits that exceed what you can make in a "day job." Also, working on the job for someone else provides skills and experiences that are transferable to running your own company; just make it an option for the highly engaged and committed entrepreneur but not for all; could reduce direct social interaction and undermine a sense of community (belonging to and working with larger groups); self-employment is already the driving force of economy, hence curriculum adaptation would be very relevant; dubious proposition to sustain the majority of the populace ;self-employment is a long-term trend.

10.2 How feasible?

Self-employment is different than autonomy, focusing curriculum on autonomy through advanced technologies: yes; self-employment is ideal or suitable for a small to midsized segment of humanity and remains a good goal, but not a panacea; this would require minimal changes, but is self-employment really needed, it may not be a priority direction society needs to head for by 2050; make it an elective, not a requirement; universities and other institutions focused on this will appear.

10.3 General comments:

Its implementation is not just feasible but inevitable; show people how to look for markets instead of jobs; while learning simple math in elementary school, apply it to learning how to use a cash book, ledger, cash-flow projection, simple math skills the self-employed should know; good idea but many implications; as the shift toward self-employment accelerates, we also see more individuals forced back into working at 'bit-rate' income levels; this cannot work without a sustainable living wage or universal basic income; more effective to learn to collaborate inside an organization than to put all the eggs inside the bag of "self-employment"; foster collaboration and the pleasure to work with others; self-employment for all could degenerate in a rat race; there was a time when your patron exploited you, now you exploit yourself and call it freedom; the purpose of education is not just for employment; feasibility of self-employment differs in agriculture, services, manufacturing, etc.; let's try to normalize pride in being what you are; we need good followers and consumers as well as bosses and artists; the small boutique or service based low skill entrepreneur with less education may easily replaceable by AI, so how to keep ahead of rapidly changing technology; corporations will like it as it removes many legacy costs...gig economy sounds liberating, but it's hiding some real issues; incorporate ways to bring people together so that people do not become overly isolated.

Suggested Action 11: Train guidance counselors to be more future-oriented in schools.

11.1 How effective?

This should be an absolute requirement; they should have easy access to research on trends and possible futures; be trained in foresight; very necessary to look at the future.

11.2 How feasible?

Get it in guidance counselor training curriculum and require them to some futures studies to prepare them for conversations with the students about the future; awareness of future possibilities should be question in the interview of counselors; no one is going to pay for this kind of training across the field of guidance counselors; replace them with "Field Mentors" who have real-world experience in the career the student is seeking

11.3 General comments:

In parallel, online guidance systems can be very effective; seems this is the lowest hanging fruit on the tree. What are they being trained to be now; the last week of every class taught at every level should be about the future of that subject; teach history AND future; this might be ripe for some kind of AI-automated suggestion system to augment teachers and to eliminate the role of formal guidance counselors; training guidance counsellors must be one among several initiatives to make substantial differences in the 2050 outcomes; how to keep counselor keep up on the trends; MP could help achieve this aim; inspiring a positive way of thinking about the future is essential to effective education; perhaps a bit less of the history of each subject and a bit more of its potential futures.

Suggested Action 12: Share the responsibility of parenting as an educational community.

12.1 How effective?

An involved community is ideal to enforce social norms at a time when technology is poised to cause big social disruption; it should not be the responsibility of the schools to fill the role of "parent;" there needs to be training on parenting, education should be a community effort; Sunday School teachers and girl/boy scouts troops are effective; "It takes a village to raise a child" philosophy holds some truth and schools are the largest stakeholder of that philosophy outside the home; however, asking teachers to fix societal problems AND teach students to be the best performers in their subject in the world is ultimately not very effective; gifted kids are a national resource that is all but ignored as we focus on getting all up the average; a young person needs a 'parent' or other person outside the educational system to take an interest in their success; shared parental responsibility sounds nice, but can reduce the impact of unquestioned love and caring that parent(s) bring; many parents, particularly the poor and those in developing world who have to concentrate on day to day existence, do not have the resources or time to provide an intellectual or creative skills environment at home to support or reinforce what is taught at school.

12.2 How feasible?

Too many teachers are already overwhelmed with too many responsibilities, but life-long learning process should be by the community as a whole; this would be a powerful movement in the right direction; parent-teacher associations could help, as would the number of students per teacher, but it seems economically unfeasible; only feasible with a flexible training model with collective stakeholder commitment; urban migration have wiped out most programs for initiating teens into adult; this may be feasible in an

autocratic society but unlikely to work for lack of agreed upon criteria in a pluralistic society.

12.3 General comments:

Since the family may be getting weaker, new institutions may have to be created in which the educational community too would have to share responsibilities; parents need to accept more responsibility; an obstacle is divergent philosophies not trusting each other with offspring; as a teacher I already do that; don't think society want to decrease the role of the parent.

Suggested Action13: Promote “communities of practice” that continually seek improvement of learning systems.

13.1 How effective is this?

Bringing knowledge communities into the learning system would be really insightful and dynamic process; should be a collaboration between schools, universities, students, business, and science and technology; most of the innovations are initiated by a single teacher, a community of interest that connects the most innovative teachers in different schools and systems to communicate with each other could speed up the validation and acceptance of productive innovations across the educational community.

13.2 How feasible?

These should be learning about learning systems; government curriculum is not able to quickly adapt to a changing world and new research on learning; some experts may not share being jealous of their practices.

13.3 General comments:

This could help lead to new institutional structures; it is happening in the maker movement and the bio-punks; but it's more a matter of school systems willing to accept and implement results; also create communities of learners and communities of graduates; may help in some areas, but it reeks of "committee" solutions; solely the responsibility of the Ministry of Education.

Suggested Action 14: Integrate Simulation-Based Learning using multiplayer environments.

14.1 How effective?

Augmented and virtual realities integrated into simulations have proven very effective in language instruction and military training, but we should not lose the value of direct social interactions in multi-player situations; simulations integrate acceptance of failure which is important for learning; move beyond "gaming" to accomplish real outcomes; simulate environments that a traditional classroom cannot; requires extensive training; gamification of everything, give the tools to unlock the unknown genius; mixed reality is the way to go!

14.2 How feasible?

Assume global online in the cloud will make the price come way down per user by 2030 in plenty of time to have an effect by 2050; this is the goal and business model for many education startups, many will fail, but it seems likely at least some will succeed in the given time frame; this is a good sector to invest in startups; need to ensure that the simulations are as real as possible; building simulated environment is more like art, approaching it with machine learning process from 19-20th century will not work; real-time group problem solving saves time and money so this should be easy to get agreement on.

14.3 General comments:

Computational science can be made available to education systems that also interact with citizen scientists increasing everyone's understanding of chemistry, physics, biology, and engineering; gamification - very powerful and likely to become more so; cost is a barrier; live feedback from multiple human 'competitors' or 'players' is much more useful than from a programmed, robotic response; some educational gaming startups are beginning to figure out the right balance and will likely prove successful in the given time frame; flight simulations for training have done a good job for years; but be leery of simulations that are more games than training; limited relevance; difficult to support long term given costs of writing/programming effective simulations; prototyping as a learning practice is increasing around the world.

Suggested Action 15: Include learning the security concerns with respect to teaching (and learning) technology.

15.1 How effective?

It is a must, but not for achieving better employment prospects; if we don't forecast potential future negative impacts of synthetic biology, nanotechnology, artificial intelligence, etc., and adjust our systems and policies to manage their dangers, we will have mega-disasters; security is a new competence to learn.

15.2 How feasible?

Will happen out of necessity given the increasing vulnerability of our systems to hacking; we need to be more proactive in addressing security gaps and the use of technology; cybersecurity is a growing career field; you can include it in the learning process but it is irrelevant; must be implemented in the strategies of the institutions and in the policies of the nations; imagine if we did not have the International Atomic Energy Agency with forecasts, standards, and governance systems - how many nuclear disasters, if not wars could have occurred by now.

15.3: General comments:

Security concerns will be built into every system in the future; it will be an important part of critical thinking to understand the difference between real security and feeling secure; paramount to understand cyber security, how to recognize attacks when it is happening and know what to do to minimize its adverse impacts; should be part of the structural design at the management/organizational levels; leaning about the potential down sides of the steam engine years ago, might have led to better industrial systems that avoid

creating much of our environmental damage today; the technological security depends on the evolution in autonomy of the AI, the regulations and interference of human in AI, tend to be late (untimely).

Suggested Action 16: Incorporate job market intelligence systems into education and employment systems.

16.1 How effective?

It is a great idea, from my experience only 10-20% of my classmates stayed in the profession; important that students know why they are getting an education and what it will mean for their future; advances in big data collection and analysis may provide accurate demand forecasts, job fit and curriculum success; I have never encountered an accurate job market prediction; it will be key in making individual empowerment effective; effective for the short-term but the question is aimed at the long-term where job intelligence would seem very limited in forecasting ability in a rapidly changing environment; it should be a major part of educational and employment systems (already exists in some countries).

16.2 How feasible?

Modern integrated systems based on big-data, real-time monitoring of demographic, professional and skills trends and analytics are already available; implementation requires leadership and central planning; requires both commitment and talent in any of its application fields.

16.3 General comments:

The more that can be done to build linkages between what employers need and how talent is being developed - the better; integration of the job market intelligence systems into education and employment are essential to improve 2050; critical in a fast changing employment landscape to remain competitive in global markets; learning analytics could be very useful to achieve the goal of a more personalized educational system; job market information should be part of training not education; essential in trade schools and apprenticeships but misleading and disruptive to university studies; job market intelligence is generally backward looking, typically introduces hysteresis at worst and large error gaps at best; make the debt one incurs through post-secondary education more productive; some universities still do not have market intelligence; this is an obvious one that should be fairly simple to implement.

Suggested Action 17: The government, employers across all industry sectors, and the labor unions should cooperate in creating adequate models of lifelong learning.

17.1 How effective?

It has already been a fact in many countries - what is needed is also a common and consensus-based strategic long-term orientation; add to "communities" in the equation;

a social convergence will be very effective; all parties would have to be ethically aware and ready to collaborate; it just complicates the system; bureaucracy, limited funding.

17.2 How feasible?

Without universities and communities actively involved in supporting life-long learning, this won't have nearly the impact that it could; many major employers are already seeing that offering learning as employee benefit increases employee retention and increases the likelihood that employees will grow into management positions; industry has no interest in bearing the costs of keeping workers skills up difficult to get alignment on the agenda with these groups, they may only protect their self-interest; too general for meaningful implementation; depends on political pressure, will, and funding which are elusive in many countries.

17.3 General comments:

Perhaps ideal but highly unlikely since these three institutions often operate at cross purposes; this seems too narrowly focused given the kinds of learning that is needed as significant numbers of people are not needed to "work in a job" besides societal support activities or self-actualization; get government out of the content side, except to offer incentives and to facilitate collaboration between learning systems and employers; so education should be driven purely by capitalist incentives? Labor unions in many developing countries are seen (and see themselves) in adversarial roles, but this may change toward more cooperation by mid-century; short term it does not look like this kind of cooperation can be achieved; cooperative business development could be an alternative to it.

Suggested Action 18: Create systems of learning from birth to three years old; this is the key stage for developing creativity, personality.

18.1 How effective?

Waldorf School system and Sesame Street are amazingly effective; all researches agree that this age is very important for learning purposes; children need multiple opportunities to discover the world on their own; importantly is to ensure proper nutrition for brain growth at this age; this early period would help maximize the creative abilities and minimize the negative aspects of inherited dispositions of individuals; make sure the systems do not destroy their natural creativity as this age; they need nurture at this time, not teaching; whom and what criteria will these learnings be developed; quality free child care should be part of any equitable society's system.

18.2 How feasible?

Ubiquitous mobile media internet access worldwide makes this very feasible within this timeframe; the research is overwhelming that this age if is really important for development and this insight will spread throughout the world; include play and affection as well as intellectual content; increasing work demands is reducing time between infant and parents.

18.3 General Comments:

At this age, most children are learning consciousness of their environment and their existence within physical space; a 'system of learning' would be a bit presumptuous, unless we mean a 'system' for free exploration; explore some proven alternatives like the Waldorf School model, which focuses initially on encouraging creativity through exposure to the arts and intuitive learning versus focusing on reading, math and book learning, etc.; with changes in biotechnology and related disciplines, one expects that it may be possible to design/program a child's creative capabilities even before birth; dangerous, it should help development, but not brain implants; I'm suspicious of this since learning is more imprinting than instruction at this young age; this could be badly misapplied for political aims or social eugenics; focus on "Game Making;" spontaneity should be preserved as well; don't standardise children, creativity declines rapidly when children hit primary school, doing this at the 0-3 level would be an absolute disaster; this has a much better chance of success if it focuses on the poverty angle; there are initiatives in the private sector.

Suggested Action 19: Create mass public awareness campaigns with celebrities about actions to address the issues in the great transitions coming up around the world.

19.1 How effective?

Efforts of Elon Musk, Bill Gates, and others over the past several years have gotten the world's attention to potential downsides of artificial super intelligence, and that was not even coordinated as a mass campaign; celebrities hold high appeal for young people which people are the biggest up-takers of education the commitment of celebrities must be at least 5 years with consistent messages to be effective; prefer: "How do we effectively utilize media to promote and educate the public?" Celebrities are just one element of that. And who is feeding the celebrities with the ideas they are promoting? That issue needs to be addressed before this can be implemented.

19.2 How feasible?

No problem to implement, just finding funds may be cumbersome but visibility is always a good opportunity for investors; no one paid Elon and Bill to take on public education about the potential downsides of AI; very feasible once partnerships are made in which case celebrities publicity campaigns be used to reach education targets especially the young people just like celebs helped drive awareness of public health issues (e.g., HIV); tap into the desire of ethically-aware celebrities to find a way to give back to society; celebrities are already doing this, mostly in most advanced countries, but overall in the world this will not have special effects.

19.3 General comments:

Making learning cool could be a game changer; celebrities, whether real or imagined, are effective in marketing campaigns, especially when the receivers of such marketing messages are able to identify with and see themselves as the celebrity or 'hero;' happens now but more needed; absolutely, but remember the celebrities are a two edged sword; watch out for hype and ideology; the campaign should be more about empowering people to think about futures, not present "the future" as an inevitable

thing; celebrities alone cannot and will not carry the message at anything more than a superficial level; a short and medium-term measure since momentous changes would have taken place by 2050 making these look somewhat obsolete, but, effect in the nearer and the medium term.

Suggested Action 20: Include futures as we include history in the curriculum. Teach alternative visions of the future, foresight, and the ability to assess potential futures.

20.1 How effective?

A civilization with a future-oriented consciousness would be at least as important to building a better future as a civilization with an historically-oriented consciousness; it would be refreshing for students to look forward instead of back; in an era of rapid change not including future aspect is tantamount to hiding you head in the sand; alternative futures brings critical thinking into the curriculum; this is a smart idea, really. I wholeheartedly hope it will work; depends on how this will be implemented; will take a huge evolution in our education system; it'll be an extracurricular subject; don't see it as some big issue regarding employment prospects by the year 2050; it has a motivational dimension not to be disregarded, fosters interest in learning; making predictions is one of the primary advantages of the human brain, seems only natural to be conscious of this capability and to practice it at a very early age; during a future-oriented high class some students realized their future profession might not be there in the future.

20.2 How feasible?

Futurists have worked on this around the world for years, some progress, but not what it should be, so not as easy or feasible as it should be; incorporate something about the future into every subject the students take; use futures methods as teaching techniques to future-orient instruction; make it more personal as a preferred set of futures for individual students; history could take on new relevance when discussed in the context of possible futures; I don't think this would move enough people in this direction; requires more research and experimentation; some aspects of the future are enchanting...exploit this hunger to enable future studies take root; easy show Cosmos series as an example; change mindset of head hunters; give students skills to feel in control after they have been given the disturbing knowledge of radical changes coming during the 4th industrial revolution.

20.3 General comments:

Make part of every subject; futures literacy is important - just as history is; if people cannot imagine diverse possible and impossible futures, they will remain stuck in someone else's version of reality; associate this with teaching innovation through hands-on practices; the last week of every class should be about the future of that subject; incorporate into curriculum standards causing textbook writers to incorporate it in their books, and will cause the GRE and SAT to be modified to include it in their questions; condition the general public to think of realistic positive futures with their

plausible place in it; the Millennium Project could help achieve this strategy; the struggle of Teach the Future makes clear, folks aren't so interested in what they can't touch.

21 Additional suggested Actions: What other long-range education/learning strategies would better improve work/technology dynamics by 2050?

- Future of Education Institutions to retrain people to switch professions
- Assess impact of changes in cultural practices/identities in the light of fast-paced technological changes
- Don't teach the same thing at the same time to everyone.
- Strengthening moral education
- Develop more effective processes to control abuses of power; and encourage a greater sense of responsibility, based on a greater emphasis on values and wisdom in our learning/educational processes.
- We must achieve an educational singularity with exponential creativity methods that will accelerate by a factor of ten people's learning ability, i.e. a 5 year course could be made in 5 months preparing multiple skills graduates that will have the knowhow to get results utilizing the current universal body of knowledge (internet, wiki, etc.). We will reach the educational singularity moment when a 15 year old will be more skilled than a 55 year old CEO. These super-educated people entering the workforce will make the difference in an unexpected way.
- Promote sustainable and equal business models such as cooperatives.
- Emphasize global citizenship education
- Decouple education from money and power politics.
- Balance the needs of the society in professional skills with the individual needs to build a strong personality able of taking the critical distance with the society.
- Try not to collapse "parenting" and "educating."
- Social literacy and social conscious should become an essential component of all education
- More technology driven education, apple's iThink project, tDCS and Brain Computer Interface, telepathy technology, Panasonic's Digital Data Transfer technology, and 2049 Singularity are all coming. We may just download and upload intelligence, knowledge, and information.

- Develop the thought leaders for all of the proposed education tracks
- Answer: Establish socially respected prizes (like Oscars or Tonys) for fine work by tradespeople and mechanics, whose work is usually taken for granted or at best paid for with money. Let bricklayers sign the wall they built, etc.
- Developing attitude to change and adaptation in individuals.
- Education to find your true interests as a human being, the importance of knowledge in achieving your goals.
- We need good teachers, good salaries, respect, and credit for teachers paramount role.
- Better research with real-time data into why/when students (particularly boys) drop out of school.
- Use AI, neuroscience, and advanced cognitive and psychological techniques into psychometrics for education and counselling: must first help people better align their education with their passions (inner-self) then create adequate and personalized plans, technologies and resources to significantly increase the share of the population that believes and succeeds with both, "academia" and "life-long learning.
- Learning strategies will be necessary to: a) provide financial guidance on how to manage much more limited resources and educate them to the fact that an "American" solution is often "the most expensive solution," and to look globally for better deals, b) teach young people how to take advantage of globalization in service-type industries, and c) imbue students with a sense of political empowerment along with the skills to shape public discussion and policy decisions.
- Lower income countries that have not "succeeded" in mass education could leap frog straight to the new approaches!
- International educational exchanges and twinning of educational programs of different countries would improve disadvantage countries to benefit from the progress of more advance ones.
- Give greater autonomy to educators in setting goals, selecting methods and experimenting with various tools.
- Reduce testing and other standardized demands from students, especially early on.

- Focus on teaching people how to learn on their own, how to collaborate, how to be entrepreneurial, how to dare, how to fail and regain confidence to try again and again, and values such as grit, integrity, resourcefulness, respect, family.

Government and Governance

Suggested Action 1: Establish a national independent (as much as possible) technology forecasting and assessment agency to inform legislative, judicial, and executive functions of government about future technology and their impacts (a government Agency for the Future).

1.1 How effective?

It could assist decision-makers in becoming familiar with new, emerging, and future technologies for more timely, relevant, and appropriate policy and legislation; could provide the necessary long-term view to compensate for the shortsightedness of politicians; China, Finland, South Korea, UK, Dubai, EC, and ASEAN are examples how long-term planning helped accelerate progress; very effective if long-term funding is guaranteed with exceptional non-political leadership and staff; it will distort the innovation landscape and will be subject to heavy lobbying; Finland's Parliamentary Committee for the Future does not allocate money (helps avoid political lobbying) and Members are the full range of political parties giving it continuity of impact as governments change; have formal connection to the policy process; access to less biased information by those who set policy can only be a positive development.

1.2 How feasible?

Easy to implement if it is well presented to the legislature; implementation needs to happen soon to have the desired impact; quite feasible if it has a small infrastructure, long-term funding commitment, and isolated from political lobbying; play in a kind of facilitator role connecting dispersed expertise; political short-termers will ignore its output, leaving it at the bottom of the institutional pecking order; the tech sector is having difficulty creating global standards and they are deeply familiar with the issues. A government agency would face the challenge of not reaching a high enough level of understanding to effect change in time; it should not be difficult as some countries have already done this.

1.3 General comments:

The agency should have a formal role in preparing or commenting on the government's technology policy; effective if part of a broader program that promotes the value of long-range planning and foresight in all aspects of life; critical in order to give society heads up to adjust to the fast pace of change; it should be a decentralized network to be effective; use collaborative software like Delphi to take advantage of the enthusiasts and experts; the Agency of the Future could be the face of the government in international fora on future technology and their impacts on the world; be open to input from the university and private sectors; its feasibility and effectiveness depend on

political will and openness of political leadership to having their assumptions and policies challenged on an on-going basis; every agency of the government should have an Office of the Future to integrate it with other agencies; this could be very useful; technology is like a fire on the horizon, destroying what's in its path, we are currently totally unprepared for what's headed our way;

Better to have a European Technology Forecasting and Assessment agency (ETFA), instead of national agencies: the European agency would be more capable by pooling EU-wide resources and be more attractive to talented researchers, and would benefit those member states that lack the resources for such a national agency and national policy units could incorporate the work of ETFA; the downside of a European agency is that it takes much longer to set up and activate compared to a national one; even if the national technology foresight agencies are established, they must be complemented by an EU institution.

A series of NBIC (Nanotech, Biotech, Infotech, Cognotech) convergence conferences in the US were aimed in this direction, but it became clear that an "independent" but functional entity in this context was probably unrealistic; the declining role of advisory bodies in politics would lead to limited impacts; if the group were perceived to have an impact, its members might be lobbied or corrupted, yet I am convinced that only independent forecasting institutions can support a better understanding of the future world; not clear why independent agency is needed since most countries have a ministry of science and education/or technology, should be part of the Ministry of Labor; much work is needed in emerging markets to show benefits of such an agency's impact.

Suggested action 2: Create international standards for artificial narrow intelligence and general intelligence and a governance system to enforce them (maybe similar to the International Atomic Energy Agency – IAEA).

2.1 How effective?

As the entry barriers to AI research are much lower than nuclear energy, the standards could serve as a useful guiding point but will not be enforced; we don't know enough about AI to work out how feasible narrow vs general AI is, never mind writing guidelines or standards for it, but I suspect by 2050 we WILL know enough, but it will be a bit late by then; it will be difficult but at least a discussion concerning those rules is highly important to start soon; will it regulate development or deployment of AI? Will it be concerned with intra-country use of nationally-developed AI? Will it monitor impact, given that causal attribution is oftentimes extremely difficult, or will it be restricted to the functional features of the AIs? Will the system rely on voluntary disclosure? Will it include a mechanism of "locking in" the features/parameters of the AI, thus ensuring that only the certified version is deployed? Innovation should be let alone as there is a danger that setting standards prematurely could hinder advancement; imagine the world today, if there were no atomic energy standards and no IAEA; many leaders from Elon Musk to Henry Kissinger have called for some version of this; computer programs aren't hazardous industrial installations; these cases aren't comparable.

2.2 How feasible?

Establishing international regulatory bodies is a protracted process, requiring the signatory parties to relinquish some of their sovereignty and convergence of the interests of key actors and support; given the potential strategic benefits of unrestricted AI development, countries have lots of incentives to resist and oppose such an institution; if the international organism is established, with the necessary capabilities, countries might not join; if they join, they might conceal their capabilities and projects (see the case of IAEA inspections in Iraq). In other words, such a project is difficult to launch and especially to complete, since it can be thwarted; there is little likelihood that such controlling standards could be effectively monitored in close to 200 sovereign states even if such standards were feasible.

2.3 General comments:

The value of a global agreement on AI is clear, but It might take a Hiroshima-scale AI disaster to induce cooperation similar to the IAEA; narrow AI is more urgent—we have a clearer idea of what it looks like and more confidence that it will impact human work and labor, but general AI is still largely hypothetical, and unless the standards are heavily informed by computer science, psychology, and cognitive science, are likely to be based on faulty assumptions; the goal is laudable, and should serve as a major step forward in improving long-range technology-work prospects; it should be easier to develop international consensus on an agency advancing the scope/role of artificial intelligence than IAEA; governments need to own the need for such standards; agreements and standards will have to be constantly tweaked as we learn more; define "narrow" and "general" artificial intelligence, as would be applied to legally enforceable boundaries of compliance; AI today is not what it will be five years from now, let alone by 2050; definition of what constitutes currently defined categories of "AI" becomes ever more blurred; any attempt to encapsulate such variations of AI definitions by current standards would likely be seen as quaint, even comical by 2050; rely more on self-organization rather than attempt to control what isn't known; quantum computing nodes and real-time quantum networks are poised to radically change what we currently recognize as "AI"; this proposal creates multiple logical inconsistencies and paradoxes - who will decide about the borderline - human intelligence; geopolitical tensions makes this very difficult; this is really necessary in order to prevent unknown underrated effects; this will be a slow, clumsy, and politically influenced process bent on fulfilling various agendas, evermore out of sync with the accelerating pace of AI evolution in its myriad emergent forms; we must deal with entrepreneurial freedom and market management in this regard, it is probable that the agency is useful to set the limits of the development, so as not to violate the systems of life or culture of the different peoples; nice to have - but not critical until existential issues arise; it is very important to establish agreed international standards so that AI can develop for the benefit of humanity, we need standards to govern malicious AI and development of AI in weapons systems. WTO is a better example since IAEA has no enforcement capabilities, yet WTO membership is voluntary.

Suggested action 3: Develop a system of positive and negative lead indicators and models to assess if we are going in a good or bad direction, giving time to adjust as needed (national State of the Future Index).

3.1 How effective?

This would highlight issues that could engender public activism and thus affect government and private sector action; it will be very useful but it is necessary to develop such system for every country; some of this does already exist with the State of the Future indicators, and a similarly balanced approach of economic, environmental, cultural and other indicators will need to be part of the set; an abstract indicator would carry much weight unless indicators are accepted across the political spectrum and very concrete; many resist anything that could be measured that might make them look bad and not align with preset priorities; The notion of good or bad direction needs much more than indicators; there is not good or bad direction but it could inform about the main concerns about the future.

3.2 How feasible?

Mainstreaming these leading indicators will go a long way towards getting them used; the State of the Future is gaining prominence and could it serve as part of the means for developing and disseminating and reporting on these indicators; the key issue, and the most demanding task, is the identification of the indicators - we currently lack a coherent vision - let alone a theory - of the future, one that would allow us to identify and prioritize the aspects we would like to seek, respectively to avoid; statistical offices are already experimenting with now-coasting, so they are increasingly open to forecasting; it is not easy to construct valid indicators - in the first stage, it is more important to collect weak signals/news concerning the use of the AI.

3.3 General comments:

Researches and scientists are saying that humanity needs alternative indicators to GDP; measurable indicators are very important to understand systemic long-term development, with respect to technological development & work, it would be challenging to establish what is good and what is bad technological development, and that assessment is also likely to change between now and 2050; rational must show how the indicators will improve understanding; the challenge is focusing on the right indicators and on getting everyone on the same page, consensus on indicators would require strong leadership across industry and government; a "national State of the Future index" would have to include extra-national lead-indicators and trends that affect national/local conditions from the outside; interesting tool to understand change; urgently required; could show what adjustments are needed; serve as a mechanism for providing feedback and prospecting for developing future strategies; as innovations and other changes occur over the years the indicators will have to be adjusted; this would not only benefit from applied AI, it likely will be irreversibly required; our capacity for developing an effective modelling mechanism as described is already beyond the range of "traditional" human techniques; some kind of systematic process will be needed to sift through and keep the reflection/monitoring process going; what about emerging properties, meaning of such norms, and impartiality; avoid assessment of indicators for

being "good" or "bad," this is always a question of stakeholder perspective; absolutely fundamental for the countries to develop their National SOFIs, only then they'd be in a position to develop a comprehensive understanding around what constitutes towards good or bad; when indicators become political they no longer measure what they were intended to measure.

Suggested action 4: Create public/private expert/citizen accessible national collective intelligence system for early alerts to problems and opportunities with ongoing emergent strategic analysis, making it easier for the public to participate in decisionmaking.

4.1 How effective?

It's likely to be the next development from polls and focus groups as politicians strive to gain a competitive advantage over which issues to pursue; as valuable as all the services provided by Google; could help to inform decision makers to take some risk; being informed by alerts about problems and opportunities could train citizens to form their own critical thinking; it is very desirable, and wouldn't this be an extension of what a number of groups including The Millennium Project and NSA are already trying to do; the challenge is to get it used enough to serve its intended purposes in practice; this kind of system can be important if it focused on weak signals or wild cards. A possibility is the Radical Technology Inquirer tool successfully implemented since 2013 in the Committee for the Future of the Finnish Parliament. Its implementation on the EU level started with the just ended RIBRI project of the EU Commission. This tool can also be a way towards a Futures Map of various scenarios related to AI.

4.2 How feasible?

This needs a concerted public awareness campaign about the need for it, so that the public would demand it of their politicians; it is strongly desirable, however limitations are at the meta-level; there will be a growing need from the political system to actively seek information about voters - as psychometrics backfires, there will be a realization that people actually want to share that information; it is not too difficult to construct a continuously developing Futures Map possibly using a tool like the Radical Technology Inquirer; objectivity may be a problem; doubtful that public or legislature would support expenditures to develop such a system; feasible but may be lacking of quality.

4.3 General comments:

That kind of system might be a new form of democracy, like liquid democracy looking for a global consensus; it empowers rather than restricts and need not be perfectly implemented to be effective; a collective intelligence system is a matter of process design, not technology; participatory activities for raising awareness of opportunities and challenges and reflexive policy making are very, very, important and should be implemented in different policy fields; assemble systems already in operation like NSA, Google, Facebook, Rand, Pew, etc., and somehow link them into a citizen accessible collective intelligence system with early alerts; isn't this the role of think tanks around the world, but some may not link/integrate their information gathering broadly enough to allow for appropriate strategic analysis; would definitely need an exceptional moderator;

benefits of such systems needs to be effectively communicated beyond the technical aspects, as few can grasp the fullness of using such an approach; the appeal of participating in such thoughtful decisions will be limited to the elite few with spare time and energy to read and think. the perceived "nerd" nature of the contributors may limit its mainstreaming and influence; valuable as part of a general program promoting foresight as by itself it could be easily ignored or not taken seriously by government leaders or the general public; the challenge will be the inclusiveness and boundaries of such systems; how to handle information overflow, assigning meaning, and freedom of speech vs. protection and privacy; requires a previous consensus about "problems/opportunities;" follow the UN MDGs.

To some extent this exists already in informal social media communities favored by experts, researchers, primarily hired by corporations "listen" to the dialogue and mine it to extract themes and patterns. It makes sense to foster the growth of these communities and to build more; public participation is always good idea; what requirements for citizen participation; seeking a medium consensus is the weakness in this approach; the public is not effective in self-governance, what is the level of representation in such a system; the public cannot and should not participate in decision-making as the decisions were made by electing their governors; requires inclusion of natural security systems for policy planning and review to be included; In the long term, it will certainly have a social learning and profound development effect, but in the short term this may create fear, insecurity, and complex tensions and demands on government.

Suggested action 5: Establish national and international liability and regulatory framework for unique microbes and new lifeforms created by synthetic biology.

5.1 How effective?

This may improve substantial developments in this new field but how much of this would open opportunities for large numbers of workers is an open question; the dangers of misused synthetic biology are potentially as bad as one can imagine; needed in order to protect future life from being overcome with new microbes and life forms antithetic to human survival; this would provide important opportunities to plan, review and assess ongoing work; having this framework is essential from ethical and biosafety viewpoints; it will be necessary but not sufficient to address the problems given low entry barriers; researchers in this field are very aware of the issues, but few outside understand the scope of the problems.

5.2 How feasible?

The USA-Europe dispute over GMOs shows how difficult this could be, yet the fear of the unknown consequences of the synthetic biology could stimulate a higher acceptance of is such measures; an acceptance of an international framework would require a response to a clear danger or a worldwide disaster with clear and unambiguous attribution; even under these conditions, the organized interests might fight back vigorously quash or water down regulations; the impact of liability and regulatory frameworks requires strong and reliable enforcement mechanisms; could be

an extension of national and WTO food, materials, etc. standards; align national and international liability and standards; unique regulatory difficulties since a synthetic organism can be created in one's home and is easy for intentional or inadvertent transmission of microbes and other life forms across borders; there is not as much attention paid to synthetic biology as with artificial intelligence, so it will take more effort to get this done.

5.3 General comments:

Such agreements are definitely needed, but will require new technical methodologies to assign liability and ways to address moral, ethical, as well as health, and social aspects of this technology; the very nature of legal frameworks will have to change to address advances in biotechnology, digital technology and AI-based interventions; these agreements would be vastly different from the kind of frameworks that we know today; since biological entities are not static, nor are their interactions with surrounding environments or ecosystems, they mutate, evolve, and migrate into unexpected areas of existence which makes definition of exactly what threshold boundary does the potential chain of liability begin, under what circumstances, and so on; measures to counter the spread of dangerous synthetic biologicals is inevitable, certainly before 2050, difficult to harmonize across different countries' legislation on new life forms; international regulations can't prevent or even seriously retard state-supported mischief or rogue science research; the need is understandable, but far from being practically implementable; not effective if some corrupted country is colluded with some corrupt company; the likelihood of cheating, if not by states but by companies or individuals, is great; there are promising signs of self-governance regarding DIYBio (do it yourself biological engineering) and synthetic biology, perhaps a regulatory framework could be agreed upon; this should not be focused only on synbio, but all types of biotech; we have this in part, but it is absolutely essential to put this in place as soon as possible; a necessary step to prevent global catastrophe but would face strong opposition.

Suggested action 6: Work with other countries to establish the International S&T Organization as an online collective intelligence platform for socio-economic-employment alternative implications of emerging technologies and scientific breakthroughs available to all.

6.1 How effective?

This has the potential to influence the electorate, which then could affect official policy choices with medium long-term effects on employment or the concept of useful work/activity; this as an opportunity to connect socio-economic issues international technology development with a broader community; it may take a global crisis to forces us to rethink our global social system quickly; it should be developed by existing International Organizations; shouldn't ILO be tracking labor trends and have a future employment section, or be trained in futures studies; this kind of organization requires transparent methods like Radical Technology Inquirer tool for Committee for the Future of the Finnish Parliament beside thematic Delphi studies.

6.2 How feasible?

If we build this within or amongst existing international labor/HR organizations, both public and private, then it should be possible to make it happen soon enough to have a significant impact by 2050; need to define all these new concepts and share them with actors: collective intelligence platform for socio-economic-employment alternative implications of emerging technologies and scientific breakthroughs available to all need to be It will be complex to organize; the Radical Technology Inquirer tool is one already in Finland tested as possibility of the platform.

6.3 General Comments:

This may energize a critical mass of passionate experts to pool their best ideas, many of these will be younger and in developing countries since they may have the most to gain; a one-world capacity would appear to be the best approach, a welcome initiative, very useful to exchange experiences among states; like so many international organizations such as the ones for trade, climate, migration or wildlife – an international organization on Science and Technology on the same lines would be needed; Bingo!; surely can't hurt to cooperate with other countries to identify new kinds of jobs and tech-created opportunities; the Millennium Project Nodes can be the fabric of these connections; would fit relatively easily within current international organizations such as the World Bank, UN etc.; this ISTO would have to be well linked to ILO and other international labor organizations if it is to be effective for employment, and would also need to be linked with vocational and formal and non-formal education systems if it were to be anything more than more information in the already overloaded panoply of information on the internet; this is something that currently practiced at international level; this is not an area that government is good at; explore social solutions as well as technological solutions; a common objective and an outlook needs to be developed (purpose of humanity); perfectly possible, but too fuzzy as a proposal; having very necessary ILO implications of emerging technologies and scientific breakthroughs part of their evolution from "everyone should work" to "everyone should be productively engaged in learning and contributing to society in some manner other whether in a job or voluntary community service or in self-actualization;" we are entering Neo-conservatism, but after that will be the era of such kind of organizations; this is the best question thus far. We need to run pilots for economic design and come up with an alternative for capitalism. We also need somewhere to incarcerate those that are addicted to greed to limit their harm on humanity.

Suggested action 7: Produce alternative cash flow projections for universal basic income to see if/when it is financially sustainable (consider License/tax robots, AI and their creations, reduction of tax havens, value added tax, and taxes on carbon, massive wealth growth from new technologies, minimum corporate tax, etc.).

7.1 How effective?

There should be many alternative cash flow projections with many different assumptions in different countries, and then compare them so we all learn what makes sense together; this one seems ripe for study and analysis and may garner significant public support; having an economic roadmap that shows the effect of UBI under a variety of

conditions would be very helpful, but such an analysis is bound to have limited accuracy; experiments being done with it should provide the basis for improved sets of projections; need public relations campaigns that will allow fair experimentation to be done with it to get the necessary mix of options available for financing the mix of options for universal basic income standards.

7.2 How feasible?

Having a roadmap that is generally believed and agreed on is not an easy task, but would be hugely helpful; it seems relatively straightforward to make projections, but whether they'll inform policy is a different question; This is quite feasible if: 1) steps are systematically and scientifically taken to analyze effects of universal basic income as an effective solution/alternative to poverty reduction, 2) the results are unbiasedly disseminated to the general public, and 3) tests of a number of alternative financing options as listed and others in order to see the reality of those sources of revenues to finance the UBIs; coordinate with other social benefit systems, but It should not give an incentive to increase the number of children; preliminary conversations have been held in Finland, Italy, Switzerland, and other countries to do this officially, so it seems a matter of time.

7.3 General comments:

License fees and tax penalties invite circumvention and reward investing myriad man-hours in legal strategies and/or outright criminal schemes to hide profits and outwit government, instead basic income should be directly funded by the profits from more reliable sources (e.g., sustainable energy production); Bravo!; framing the search for solutions to inequality in this way is highly likely to produce practical ideas; effectiveness depends on how the projections are received, are they seen as neutral or as political propaganda; a future without jobs is the reality - we need a new social contract as soon as possible; critical especially as substantial number of jobs are eliminated; this issue is the most important for the future of the socio-economic system; include the analysis of the impact on inequality levels of sustainable and equal business models such as cooperatives; basic income ought to consider work for pay to preserve human self-worth; without some sort of economic roadmap we'll be making changes blindly; even a crude range of alternative models would provide some needed fuel for the political discussion; if several countries prove the concept over the next decade, then the final two decades could be enough to have a substantial effect by 2050; in addition to cash flow, the Protestant or "work" ethic has to be addressed; there is support in Pakistan for state-run action, but negligible in the private sector; complicating factors: lack of a verifiably, reliable, and predictive economic science and the seemingly inseparability of politics and ideology from economic theory; I believe in Silvio Gezel's model for using the distribution of the negative interest rate as a UBI on a daily base; do this, to better understand why most current approaches for basic incomes would fail and to find out what could work better; yes to demonstrate that such policies are not sustainable - a deep change in economics principles is needed; extremely difficult/impossible in the present socio-economic system; universal income a pessimistic approach to the future of employment; much skepticism in Latin America about this issue; impossible to

implement at the international scale under the existing international political/economic/security order.

Suggested Action 8: Insure international coordination prior to implementing Universal Basic Income to prevent enormous political and emigrational pressures that may arise with non-UBI countries.

8.1 How effective?

Very important or else future migrations can be more massive and destructive than what has occurred over the past several years; global realization of the SDGs is paramount to avoid the absurd levels of illegal immigration; doing it at a larger scale, such as EU makes more sense than for individual European countries—however, the argument of purchasing power parity is bound to appear; will highly "robotized" societies agree to share their wealth with the overpopulated non-UBI countries; global coordination would seem to be putting a roadblock in front of real attempts at UBI and without some large successful tests to point to, the majority of the world will remain skeptical; the premise "if implemented" seems farfetched but this certainly would ease the effect of AI/automation on standard work; it's hard to have a meaningful conversation with those than think migrations are destructive, such a phrase indicates a lack of basic humanity, anyone migrating is migrating for a damn good reason.

8.2 How feasible?

Likely to be brought about by necessity; if immigration reform is done in concert with and integrated with UBI experiments, and those results are shared broadly across the world, while simultaneously promoting and supporting indigenous socio-economic development in underdeveloped states, then this could happen enough time to lay the ground for fuller implementation of the UBI and "future life" ideas; inconceivable implementation under the current state of social consciousness in the rich and in the poor countries; some sort of global coordination effort could probably be put in place by 2050, but I think it will delay rather than speed the timetable of economic reform that is needed.

8.3 General comments:

This would be a pre-requisite for implementation, but the anti-immigrant sentiment would need to be quieted before representatives could negotiate; each country will decide for themselves - one country will welcome refugees while others will not; but regional coordination is more likely than global coordination; how would you ever enforce such coordination; ultimately will need universal UBI aided by "abundance advances" that lower the cost of living; UBI is a very possible, probable and plausible scenario but it won't happen simultaneously; better to invest in UBI rather than prisons or walls; this is the solution for the most part of the problems carried by AI revolution; will have to be shown to work in a variety of different countries before (or even IF) it becomes globally accepted. International coordination is a bad idea as countries with a successful UBI program *should* experience emigrational pressures that will show the world that its working, and most of the developed world should be more open to emigration than it is now; not likely that international coordination will be achieved

before any country implements UBI but that does not preclude UBI from happening in such places as Scandinavia (e.g. Finland or Denmark), but the immigration issue will have to be addressed before UBI implementation in larger counties; finding ways to reduce the inequality gap could go a long way towards reducing the burden of UBI; link it to self-responsibility approaches; countries where the UBI is very LOW would start aspiring to a higher income making it potentially unworkable; UBI is a closed road; unlikely to be implementable the same at the international level—it must happen at national levels; there won't be any neat solutions - some way has to be found to get out of the mess.

Suggested action 9: Place a tax on robotic work, and other Next Technologies (NT).

9.1 How effective?

Source of income to help the unemployed; productivity of robots' work could be used to develop new jobs for humans; the entire concept of tax structures and money needs to be rethought in a world where robots create most of the wealth; idea seems to need further definition, because, are not Alexa and Siri doing robotic work; this should slow down the displacement effect but may not matter in the very long run except to help fund some type of universal basic income; a tax on work is not what is needed - rather - taxes on resource use and consumption; taxes should focus on basic resources like energy; this is a negative effect—drain on potential work related to NT.

9.2 How feasible?

Seems inevitable, just like we do for cars; the demands of the economically displaced for assistance should eventually overwhelm the business/technology lobbyists in democratic countries; in the short term, some sort of tax on robotic production might be effective, but it will just accelerate movements towards forms of money such as cryptocurrencies which are harder to tax, but if a government undertakes to both support a crypto-currency by ensuring the safety of the blockchain and take a small percentage cut on every transaction, then this might be a way to replace the old tax system with one that could withstand the upcoming economic upheavals; why are we trying to tax "robotic work" in the first place? Is it generating economic benefits that are not being accounted for somewhere in the process of their provision, or are we just looking for another source of tax revenue to cover unfunded government expenditures?

9.3 General comments:

It is being embraced by world economic voices/leaders like Bill Gates and international organizations and forums; taxing robots and other NT is an attractive avenue to provide new sources of tax revenue to fund initiatives such as UBI; possible as more and more people are replaced by robots; the tax should be clarified as to purpose and use; this might work in selected countries (e.g., Canada, Scandinavia, perhaps Europe generally) but seems hardly likely to be workable worldwide; Very useful as a means of making investment and resource allocation decisions and tracking their effectiveness over time; tax profits not robots; this may be feasible to implement but I think it's a disastrous idea – I have worked my entire life to help bring on a robotic revolution so that NO ONE

EVER NEED WORK. If our current economic systems cannot handle the idea of there being enough for everyone, for free, then we need to replace those systems, not restrict the arrival of a post-scarcity environment by penalizing the use of robots and AI; how is this "work" not already being taxed, either through the sales tax for the technology or the services provided, or through net income tax on the providers of the robots;

If increasing productivity and standard of living by NT which allows for financing the paid jobs in science, culture, and leisure all is fine, but if it leads to even more concentration of wealth unemployment that UBI would be needed; robotic work is almost impossible to define; the boundaries of robotic work are fuzzy, much of it is not presently visible, it also crosses national borders at high speeds, companies would need a reason to make it more visible and to quantify it, this suggests the need for an international regulatory/enforcement agency; it sounds like a regressive measure, given the spread and pervasive power of new technologies it will be likely taxing air; this could become a reality when robot-driven unemployment becomes a major issue, but I don't think tax would have positive impact (imagine if we tax renewable energy instead of providing incentives..).

Suggested Action 10: Apply AI (narrow AI, but if general AI is invented, then that too) to governance for decision-making to improve anticipation, problem solving, and efficacy, efficiency and evidence-basis for public plans and program.

10.1 How effective?

Agree that the effect is all in the implementation, but great potential exists; will improve feedback based on outcomes—AI should say what the intended consequences of the legislation are, and if such consequences are not achieved, the legislation automatically lapses, AI's may be less fallible than politicians but they can only advise as well as their models conform to reality, and it's easy to miss important factors; general AI and Machine Learning have the potential to identify and resolve problems in ways we cannot conceive; if governance AI is designed to add rigor of thought, then that would be great, but any trust in black-box algorithms is an abandonment of responsible governance; this could result in massive layoffs of government employees, potential cost savings; most likely it will be a decision support system, not an automated decision system, principle of final human responsibility should not be waived, any automated action has to be linked back to an accountable human decision-maker; useful for well-defined tasks that involve handling large amounts of unambiguous information about observable phenomena creating trend extrapolations and pattern extraction, not at sensemaking, and understanding discontinuities introduced by disruptive technologies that alter the inner logic of the whole system, as they are unable to grasp the significance of events or to discern the tiny seeds of future developments from the noisy background of randomness; fear and emotion and other "human flaws" are proxies for un-measurable and non-quantifiable factors, and the key to good political decisions—fear is one of the prerequisites for good decisions; very few decisions at central level that can be "given" to AI as most of it is creating regulation but possible for the local level—building permits, local planning, etc.

10.2 How feasible?

This is already beginning, will be difficult to stop; AI should be required to be able to explain and justify its decisions, yet AI developers cannot always exactly explain how the self-learning parts of their algorithms made their final decisions; DARPA's Artificial Intelligence Exploration program is intended to be contextual and able to explain itself; there are billions of test items for image recognition, but not for policy decisionmaking that must confront novel & unexpected situations, which means there will always be some uncertainty and apprehension about the quality of the AI solutions, sentiments that can be successfully leveraged by the opponents; politicians and bureaucrats will not like to be told by AI that their policies are not working properly or are bad; this happens already with many algorithms, to many ill effects, leading to the nickname "weapons of math destruction."

10.3 General Comments:

As a supporting decisionmaking tool - of course; experiments in this direction are already taking place and will have substantial effect even before 2050; AI (both narrow and general) for governance is desirable and hard to resist, all tools that would assist in helping better decision-making should be utilized if feasible; necessary, important and feasible, there is too much information now about our increasingly complex problems, we need AI to help distil it and detect meaningful signals; this would shift the power from politicians to those who make the algorithms/AI systems, it can be done in a way that ensures transparency, accountability and representation, but requires a careful approach; efficacy of this would be tremendous in times of tremendous resource constraints; humans will still be needed for the more subtle reasoning; economic or logistical criteria for optimization should be relaxed when they conflict with protection of vulnerable persons; AI for decisionmaking is a worthwhile goal, but also scary, what about hacking and malware; AI is needed, but a major challenge to get approved legislation as there will be outright attacks from vested interests; the cost of mistakes might be very high, and nobody will be responsible for that; it's the very worst idea in this list; could AI replace religion, economy and government?

Suggested action 11: Training programs for politicians before governing and prototype governance methodologies.

11.1 How effective?

Necessary to learn interdisciplinary studies of complexity of the modern world; the model of the Finnish Committee for the Future has worked just in this way; make sure tools of policy analysis and implementation are the main focus not ideology; use data and insights collected from former successful politicians on how they successfully produced new legislation and they get out-dated legislation off the books; not necessary to be a university graduate, we want to be sure that ordinary citizens can effectively serve as representatives in Federal government, and that requires training programs; require a President to have the equivalent of a PhD in political science, with lesser degrees required for lesser positions would seem to be a great idea, provided that we had universal free education so that it was not a barrier to a poor person becoming a politician; such training is implemented in local governments on a regular basis with

both experiential and evidence based training; this has to be better than what we do today.

11.2 How feasible?

The Finnish Committee for the Future has shown that this is very feasible; there is sufficient time to implement such a program for the next generation of officials but successful politicians in democratic societies are not successful on the basis of their expertise but on their connection with the common electorate and thus are not likely to expend much time and energy on these types of programs and training; should be part of the orientation of persons new to office, who can in turn educate their constituencies to the successes and failures of government such that there is appropriate demand for legislation from the general public that goes beyond partisan rhetoric; An after-the-fact training program for the already elected would be useless because it would need to have teeth or else it would be ignored. And if it had teeth, it would be strongly opposed by current politicians.

11.3 General comments:

Training on evolving how-to's of governance is needed prior to any politician taking office, but no separation by political party so they would begin to get to know each other personally and begin to build their working relationships; very desirable but needs a) consensus on content across industry, government, and academia; b) political will and ability to monitor their adherence to the methodologies plus the quality of their results; c) consensus on accountability; and 4) ability to censor (or retire) those who violate their "charter;" create a futures literacy index for politicians and it obligatory for political candidates to know; increasingly needed as governance becomes more complex with increasing technological interventions; The Millennium Project could help achieve this strategy; electoral reform may help put this in place; US such "training" might well be considered undemocratic or downright manipulative; needed as amateurishness dominates much today; politics is usually driven by voters interest more that grounds of governance; really important, essential, very useful and logical; but might prove impossible to implement.

Suggested Action 12: Include self-employment issues in political parties' agendas and manifestos to promote social dialogue on these issues.

12.1 How effective?

While this is a narrow issue of marginal utility as self-employment may not solve the bulk of the work displacement problem, it may also stimulate public discussion in advance of the general problem posed by AI/automation; this will become a natural tendency of economic development; hard it is to get small businesses' agendas and policy needs into any political party's agenda, and double that difficulty, and you'll have the challenge ahead of us on this; it should be done anyway, because self-employment could be an increasingly significant factor in the overall employment picture in the coming decades; Flexicurity is already in the programs of most parties and it doesn't change much.

12.2 How feasible?

If we do get artificial general intelligence, then this will seem necessary; time to include this in political agendas but broaden the discussion and then transform solutions into practical actions well in advance of when the problem creates major socio-economic effects; agreed that broadening the discussion and transforming solutions into practical actions is needed before it becomes a problem, but there was a surge in self-employment when companies started to outsource work, legislation made it a crime for companies to hire someone full time as a consultant and not provide them with full benefits of employees, which in turn reduced their numbers significantly, so unless some of the issues related to self-employment like health insurance are addressed, then there will be an ongoing ebb and flow in and out of the self-employment ranks, even with all of the technological changes enabling of it; self-employment issues will be addressed differently by different political parties, rather than being a cohesive non-partisan platform.

12.3 General comments:

This is one of the most anticipated future trends that parties all over the world will prepare for; Brazilian political campaign is talking about this; this could truly trigger the dialogue at least; it is highly likely that self-employed people will aggregate into groups with the influence of unions and membership in these groups will continue to grow; individuals shall become much more autonomous in their choice and design of jobs making a different order of the 'informal' economy; aggregation of self-employed into groups will be needed if the social dialogue is to happen; promoting more dialogue about changing work goals and redefining what constitutes respected employment or use of one's time is very relevant; self-employment's actual impact could be much lower if a new "organized work" definition would replace obsolete definitions of "employed" and "self-employed;" getting these issues in political agenda we might get more bloviation than substance; focus on social entrepreneurship and innovation, that creates sustainable jobs and reduces inequalities.

Suggested Action 13: Establish an online platform for citizens offering their skills, services for full-time, part-time, one-time jobs.

13.1 How effective?

These new platforms for citizens will be more efficient than today and will be able to take into account knowledge and know-how more complex than now; on-line platforms already exist, either through websites and commercial channels or by government. A national or international uniform platform may provide some amelioration but may also lead to a race to the bottom with respect to salaries and working hours and conditions; See the experiences of Portfolio in Wales.

13.2 How feasible?

As such systems exist and are constantly being improved, this should not be hard to implement; many organizations are doing this inspite of the government, perhaps the outreach would be greater if the government did this.

13.3 General Comments:

Matching people with skills to people with needs is a win-win; making this easier and more reliable is a clear benefit to society anywhere; the "dots" network created in Brazil with this model and is growing rapidly <https://www.rededots.com.br/>; the biggest barrier to this could be government hiring regulations; already happening media platforms like LinkedIn, etc.; the informal sector may eventual be a significant sector in providing jobs to the citizens--who shall have more autonomy and more choices; apply narrow AI to this; these platforms should reduce inequities; add volunteer opportunities as well.

Suggested Action 14: Make skills re-training vouchers available on-demand.

14.1 How effective?

Some companies laying off employees often provide these; public and private sectors collaboration needed to be effective, and perhaps even mandated; funding will be challenging.

14.2 How feasible?

If retrying vouchers mandated to be available on demand are legislated within the next decade, then it could have a significant impact by 2050.

14.3 General comments:

If economists can make a compelling case for the return on investment for the business sector, it may be possible to fund this through some kind of business tax, business organizations would be better positioned to credibly market the voucher program; a legal framework between employees, employers and government must be established; re-training is a consequence of work-technology prospects over the long term; such vouchers exist in Europe and they will become more important; who pays for these vouchers, who will do the training, is it both for the very young and very old; if it's free why not take it--if only to put off having to settle for some real world job; this would have to be skillfully marketed to the public so as not to appear as another "entitlement program" with connotations of gifts to the "un-deserving;" if you don't have enough young workforce, one answer is to train the elderly so that they can work with new skills; the promise of a job should be changed to a promise of retraining; the longer run would require the creation of whole new fields of work that also need human labor in equal numbers, which seems doubtful in a practical time frame available to those being displaced, as new types of activities made possible by new technology normally take close to a decade or so to become major businesses/industries.

Suggested Action 15: The government, employers, and the labor unions cooperate to create lifelong learning models including forecasts of future skills requirements.

15.1 How effective?

Lifelong learning models help stakeholders to converge to a shared vision of the long-range work-technology 2050 and to build it; cooperation will be very beneficial, but they

tend to see each other as natural born enemies, maybe make it a competition amongst them.

15.2 How feasible?

ILO and others are already moving in this direction; agree that some of this is already happening, but not in such a coordinated fashion; I have some doubts that the majority of people can adhere to lifelong learning and knowledge updating in sophisticated subjects, which perhaps require considerable mathematical and flexible technical skills, to find an employment niche in a world dominated by AI/automation.

15.3 General comments:

Lifelong learning models are an imperative, and the future skills forecasts are a good exercise - but they must concern pretty short time periods or they may do more harm than good; Europe produces experts who are not need anymore because education has lost connections with business and the labor market, the best formula is the triangle of government, employers, and labor; if such a community can be fashioned it will be formidable indeed, until then, local and national cooperation may suffice to provide examples of success; include cooperatives on this strategy; keeping education and business connected is paramount to this process and education systems need to re-educate themselves to the realities of the changing world; critical to remain competitive in the global markets; it could work if it is socio-economical public action, not a business for not-profit subjects like European Social Fund; a tremendous amount of education is need to adjust to the new economic models required for human survival.

Suggested Action 16: Establish self-serving pension system with subsidies for those with lower income.

16.1 How effective?

This kind of privatized Social Security is having problems in Chilean, so better to consider UBI; this system could allow balance in a period of strong transition and protect the weakest; give with some regulation since sometimes giving prevents initiatives; assumes that there will be non-marginal social groups permanently sentenced to be at the lower strata of the social hierarchy, will it be extended to a system subsidizing all citizens of the less-developed countries by the citizens of developed countries? It is obvious that the people who are incidentally unprivileged, e.g. the disabled should be supported, but we should not confuse this with creating permanently unprivileged groups and such is a hidden agenda of this issue.

16.2 How feasible?

This sounds a lot like privatized Social Security pensions; I don't see this happening anytime soon.

16.3 General comments:

In contradiction to universal basic income; if privatized Social Security then some serious investigation of the lifetime viability of such as a system is needed for the general population; many in Central and Eastern Europe are not satisfied with their

pension system because they are not getting back what they invested during their working life; we have endless budgets for war - but apparently none for decency, anyone with a heart would want elderly to be fed and clothed without exception; how to transform pension system without losing the principles of solidarity and subsidiarity; is technological progress generates sufficient surpluses then this is possible; freedom of choice own pension system will be a challenge for the future welfare state; some vocal citizens see this as a wealth transfer to the "un-deserving" create barriers to it feasibility; share responsibility between workers and government to save and invest while setting new models for "the good life" that make conspicuous and/or wasteful consumption by anyone unfashionable.

Suggested Action 17: Create and implement a global counter organized crime strategy.

17.1 How effective?

Without it, organized crime will buy the best software talent money can buy and create ANI and AGI to make them far more powerful than today, making democracy and free markets an illusion; wasn't Interpol supposed to be doing that? They turned out to be corrupted themselves. So while this is needed, great care will have to be taken to keep the new system uncorrupted, since organized crime will try to counter it; a global strategy is not likely to be useful against decentralized organized crime.

17.2 How feasible?

It depends on leadership, which so far is not there, governments have taken on drug cartels, but the future problems with NT (next technologies) are far beyond drugs; leadership with broad public support will be the starting point, cybersecurity is already proving to be a major activity of organized crime globally, and the challenge will continue to be in trying to keep up with the criminals technologically enough to be able to track them down and bring them to justice.

17.3 General comments:

It's highly feasible since there consensus and sense of urgency are becoming more widespread as attacks proliferate across borders; Yes, it is badly needed, but as long as certain countries are run by criminals, it will be challenging to implement a global strategy; money laundering becomes more difficult to track due to blockchain and other tech, and this (e.g., cryptocurrency fraud) is creating new profit opportunity for organized crime hence action at global level is necessary; the system is quite necessary but we can predict how possible it is evaluating the situation in UN; strongly necessary, business and consumer confidence in technology depends on security and privacy, there is already a trend to seek refuge in lower tech ways of communication and problem solving (i.e. meetings in person, snail mail, etc.); a common definition of organized crime would have to be initially worked out; we have Transparency International and law enforcement cooperation; crime thrives during times of extreme economic injustice. Focus on reducing inequality and white-collar crime, a strong middle class is the best defense against organized crime.

Suggested Action 18: Promote leisure, culture, tourism, and entertainment industries.

18.1 How effective?

If the world workforce is over 6 billion in the year 2050, what percent of the public could really be employed in these sectors; if sports is included, then most people could participate and a mix of entrepreneurs and/or government will likely find ways to monetize this activity so that it constitutes at least partially remunerative part-time employment for all, somewhat off-setting the cost of universal supplementary income; ever more important as world continues to automate amid of a search for "personal value;" this is obviously good in scenario 1, but if scenario 2 occurs the these industries will be mostly for the wealthy and governors of the NT technologies; these already are some of the fastest growing employment generators, and with more leisure time looming in the future because of automation, these will continue to be growth industries; the culture side needs more exploration.

18.2 How feasible?

Even with automation, these industries should provide ongoing opportunities for gainful employment; synthesizers didn't replace too many musicians, and the number of sports should continue to grow as well; depends on the scenarios of consequences of automatization of work; these sectors don't require lengthy, intellectually demanding education and are sufficiently popular so as to reduce future political opposition, sports and entertainment can become the equivalent of the Roman bread and circuses except that both the spectators and participants may be willing to pay for the activity.

18.3 General Comments:

It is imperative to turn to less material-intensive lifestyles for the humankind to survive on this planet. Leisure, culture and entertainment are key in this, tourism less so; great opportunity for aging populations; meaningful service to some cause or community is often more desirable than a life of entertainment and tourism so encourage the option of service in spite of, or along with, care-giver robots and advanced AI; inevitable consequence of technological growth; it is well underway with expanding new media and improved production technologies – how many jobs will virtual reality create over the next three decades; great cities are promoting this now attracting investment and the cycle continues to grow; what remains to be done is for governments to transplant this "virtuous cycle" to smaller cities and rural areas; make sure government promotion does not become propaganda; in addition to promotion, add training courses in culture, music, etc.; good for reducing economic stress and paying people to create culture.

Suggested Action 19: Create a new social contract between government and the governed (previous: go to school, get a job, and then receive retirement benefits).

19.1 How effective?

This is calling for a very fundamental cultural change, which will be a different process for every country in the world. That is needed if we are ever to get to a world in which self-actualization is considered an honorable and socially responsible endeavor, then a

new social contract will be needed between government and the governed; all depends on what the new social contract is and how it is implemented, but if done reasonably well could have major impact.

19.2 How feasible?

Very challenging to say the least, as the entire economic basis for government is that people work and pay taxes to the government, so there would have to be new business models for government along with this new social contract; the elements of this "new" contract may be resisted by proponents of the status quo.

19.3 General comments:

Current global societies urgently need a new social contract base-artificial intelligence and life, longevity and mortality, robots and labor, etc.; there are precedents for this kind of contract in countries that require national service as well as various kinds of student loans that can be repaid by working with under-served populations (teaching/medicine, etc); given the rising cost of education, loan forgiveness programs offer a potentially broadly acceptable template for expansion into something like this; new culture, and not just the social contract between government and the governed; we need to get beyond the "we" them" dichotomy and create new economics and finding ways to mitigate the imbalance of power between global corporations and the rest of us; this is the first step to build a sustainable system; we need to proactively engage in economic design - otherwise we'll spend a fortune mitigating the consequences of our current winner take all economy - capitalism isn't sustainable; government should continue to provide those services that people cannot supply on their own (defense, public works, etc.) while education, satisfying life activities, and retirement security are partly things that people can attain by their own efforts, and ought to remain so, but we should not rely wholly on government, robots, and/or AI for cradle-to-grave support (read Jack Williamson's novel "With Folded Hands"); two emerging scenarios for social orders: contracts among the partners and "contracts" imposed in a sophisticated way by the "governors of technology," the degree of imposition would become so sophisticated that the 1984 seems primitive (Study Baudrillard's simulacra); it seems inappropriate to attempt to rate feasibility when the proposition is too vague and general to be meaningful.

Suggested Action 20: Develop governance for the future human.

20.1 How effective?

How to govern NT augmented geniuses, that can get smarter every day, can a governance system also augmented by AI keep up, if personal AI/Avatars proliferate – are they “part of” the future human to be governed; who can see the future human well enough to guide the redevelopment of governance.

20.2 How feasible?

Although we can imagine, as science fiction writers have been doing for more than a century, possible future humans, how can we be sure whose vision will become reality, hence hard to define what governance will and will not be needed; very complex to implement to meet the expectations of all on work and technology 2050.

20.3 General comments:

The world is facing global transnational problems, so it needs global governance and reform of institutions such as UN, WTO, WHO, etc.; applying to the augmented and non-augmented—it HAS to be done!; rather than governance for the future human, we should make sure we create resilient systems (e.g., around human dignity) that are still applicable in the future; people will pick a country of digital citizenship and migrate as much of their lives there as possible (Estonia currently offers e-citizenship, others will as well); it would be indeed appropriate and honorable to take into account the interests of the humans of the future, instead of dumping on them the costs and consequences of our actions, none of the present-day legislative bodies includes an ombudsman for future generations, but all of them should; AI-enhanced beings or simply ordinary humans born at some future time - I suspect governance will evolve on its own, but how can we anticipate the way government will or should change without some concrete idea of who is to be governed; only foresight-oriented cultures could do this; we aren't yet beyond Maslow's hierarchy of basic needs, but we could make good progress towards that in the next 32 years if there is a dramatic shift away from the current global materialistic society to one much less materialistic, and one looking to explore its other elements; this is too broad, too vague, and needs clarification; the question is trivial if not absurd; if the implication is that the future human is not a standard homo sapiens, then there is a problem of legitimacy of the governance to address; i.e., it is the future humans who should develop what they think is appropriate, once they exist (which seems unlikely prior to 2050).

Suggested Action 21: By 2050 introduce a global system for resource sharing (all kinds: scientific knowledge, technology, labor).

21.1 How effective?

Open source movement already exists; builds on current trends and could normalize work-technology advances; the Information Society with utopian anti-capitalist ideas of limited private property, equality, no material barriers, reduction if not almost complete elimination of asymmetry of information and of its consequences, reduction of transaction costs could lead to a new market with less discrepancies, but also ideological conflicts; this exists to a degree already and is the intention of the WTO, no? Free trade globally, but most countries are not so altruistic, there are numerous global societies and associations that try to share information in the fields of health, agriculture, industry, accounting, etc. But what happens to patents? How do individuals and companies and governments recoup their investments in new technologies and systems and methodologies and physical resources? Ultimately, this needs to happen in order for there to be orderly long-term human survival on this planet. Technology can help this process, but we have to realize, as Facebook and others are beginning to realize that technology for good can also be used for bad and so we have ways to protect from such misuse on massive scale as has been happening of late if open sharing is to be feasible.

21.2 How feasible?

This is the current trend but naturally issues of intellectual property rights may need to be revised if such sharing is to reach its full potential.

21.3 General comments:

Seems the world is heading this way, but conflicts will not make this universal; a noble ideal but what might motivate such cooperation on a global scale, maybe necessities from the environmental crises, and/or resource shortages; but conflict seems a more likely result, but a project that could capture people's imaginations worldwide could work such as the exploration and peaceful settlement of other worlds in space; it has already started with sharing and circular economy, problem is that it is not capitalism-effective, so business and corporations have to be ready to face that dialogue needed in all international fora, from WTO, to the UN, to CGIAR, to WHO, etc., bigger and more advanced countries often walk away with the icing and the cake, given the prevailing disparities in the international system, it would not be an easy thing to achieve; regional systems might be more feasible.

Suggested Action 22: Study how to prevent future conflict between technologically augmented humans (via, AI, genetics, electronics or other means) and non-augmented citizens.

22.1 How effective?

Important conflict/tradeoff area to resolve as it is at the heart of positive human-technology development; difficult and very important to radical rethink technologically augmented versus naturally augmented humans better utilizing their innate abilities more fully; absolutely necessary, however those who potentially could influence the process may not comprehend the situation, attempts to stimulate the emergence of such a polar situation would demand a very deep understanding of society, even so, they might be counterproductive for the initiators; this is serious, more serious in the future than the concentration of wealth today, assuming it can be done, it would be very important to avoid very complex conflicts, making current information warfare look simple in comparison; this seed for science fiction movies is going to be a challenge to prevent.

22.2 How feasible?

Now is the time for consideration and resolution of these issues, before strong conflicts arise; this is likely the most challenging ideological, political, economic and security issue in the years to come, it demands deep interdisciplinary studies, the main question is: what are the possibilities of influencing the emerging new social order.

22.3 General comments:

It is a crucial issue for the future; this will become part of the strategy to address rich-poor gap both global and national levels; mitigating conflict and political tensions between the new haves and have nots will be challenging; humanity needs to raise its consciousness - more scenarios and forecasts are needed; related conflicts could occur over equal opportunity to be augmented, between employed and unemployed, and

among a range of different technologically augmented humans; will people be able influence this emergent process of a new order, or will the augments concentrate power; adding AI and other tech enhancements will expand the range of "differing abilities" but not materially change the situation that exists today, yet further in the future the augments might isolate themselves into new communities in space.

23 Additional suggested actions: What other long-range education/learning strategies would better improve work/technology dynamics by 2050?

- Develop a real-time, artificial intelligence, collective intelligence, participatory decision-support system for the United Nations.
- All levels of education should explore potential futures we want in 2050.
- Teach AI-enhanced working methods in school.
- Build shared visions nationally, regionally, and globally.
- Bring up these issues in political campaigns.
- Develop new inter- and multidisciplinary methods for understanding the emerging complexity of the modern society.
- Develop more robotic and AI devices that enhance the abilities of human workers rather than replace them entirely.
- Produce trusted personal natural language digital avatars/"twin persons" to help in an increasingly complex future.
- Create an international consortium for studying/sharing strategies for improving/nurturing human spiritual intelligence and its impact on local and world-wide governance systems.
- Create an effective world governance system without compromising nationalism of each nation and without compromising freedom for all people.
- Allow diversity of values to flourish along with diversity of lifestyles, more progress is made when differing theories are tested against each other.
- Use pro-free market incentives and programs to better work/technology dynamics by 2050 including decentralized banks and financial institutions.
- Set a goal to establish life outside of our planet to ensure continuity of the human race in case of earthly catastrophes, these off-world settlements [don't think of them as "colonies" created to serve the needs of Earth] on the moon and other planets can inspire enthusiasm and hope for the future.

- Make it a top priority to take care of our planet - natural resources, pollution etc.
- Recognize implications of the potential "zero-marginal cost economy."
- Promote technology that lowers the cost of living and ensure it is accessed by low income populations.
- Make this information available to community discussion groups www.Argentina2050.org.
- Promote entrepreneurial innovations by linking to incentives other than financial success and prestige.
- Re-conceptualize "work" in this context of this study.
- Make politicians and government officials more science and technology literacy so that they are prepared to take on the issues discussed above.
- Continually train employees about new technologies.
- Review International Law to see how every human being can come under a common standard of citizenship including passport and visa as a birth right, only a felony conviction can change this entitlement, include free access to health, education, water, and the Internet, plus no restrictions on private entrepreneurship except state control for goods and services.
- Promote citizen participation at all levels of government.
- Governments should provide incentives for a healthy lifestyle managed by integrated healthcare monitoring technology.
- Intersperse education and work by increasing standard education by several years to let students work in between desk studies to have get work experience, keep in touch with teachers and researchers at universities for a longer period, and make students used to life-long-learning and learning phases while working in companies. This would also increase knowledge transfer between students/people from industry and researchers, and would improve cooperation skills of students.
- A Moonshot Project for a Longer and Healthier Life including public investments and dedicated artificial intelligence).

Business and Labor

Suggested Action 1: Promote and invest in Kickstarter-like crowdsourcing to reduce the concentration of wealth.

1.1 How effective?

Crowdfund investing, not merely crowdfunding, can provide access to capital independent of location, and allows individuals to participate in investment opportunities currently blocked through regulation; venture capital has been mostly for the rich, ROI comes back to them and increases the concentration of wealth, if the general public began to "economically vote" for the future they want, the new wealth would be less concentrated, many people have great ideas, but have no easy way to get to venture money, such people—or most of them—do not know that Kickstarter exists and those who might support such ideas do not know that they can play directly in the venture capital game, when they do, the concentration of wealth can be altered, idea is to get ALL the world involved; potential to make a significant difference if targeted to the right areas; allows aid to reach people without being easily subverted; crowdfunding encourages entrepreneurship, adds to the diversity of products, innovations, and numbers of people in the creation and funding process, yet not clear it would have much impact on the concentration of wealth; enough discussion, just do it.

Kickstarter may evolve into a type of Amazon-like online store, or custom-order service to facilitate the wealthy receiving unique goods outside the mainstream production and distribution lines, but does offer a term-limited opportunity for a small company or inventor to sell a limited number of products, where they do not have the marketing capital and distribution system to reach a larger audience; offers a term-limited opportunity for a small company or inventor to sell a limited number of products, where they do not have the marketing capital and distribution system to reach a larger audience; someone with means could purchase their Kickstarter product and patent it before they do, unless patenting becomes a less expensive process, which could result in greater opportunity for individuals to attain great wealth through their inventions and products; and thus make a difference in wealth redistribution; Kickstarter is more likely to produce less necessary fancy and sophisticated businesses instead of long-term businesses; social media and development of IT could diminish the role of the banks; access to finance has not proven to lead to reduce the concentration of wealth; Kickstarter beneficiaries are likely first-world middle-class and up; situation requires a more systemic approach.

1.2 How feasible?

It's already in place and effective, the only question is will it grow enough to make a difference by 2050; This can be done inexpensively, and I suspect Kickstarter is here to stay; thanks to technology, it will be easy to implement, as long as we work together; requires a legislative change to easy crowdfund investing with templates like JOBS act; more angel and other funding mechanisms are being started each year, but to affect the concentration of wealth will take a huge fundamental cultural shift about the game of business as a social enterprise; 2050 is a long time away, there is enough time to make

these changes; links between inequality and new (r)evolution of the market system is not clear; not sure if will sustain in enough time to make a difference; all depends on how much we push it.

1.3 General comments:

It is a theoretical possibility; this could be extremely effective if there is a strong will on the part of governments and other interested actors who have wealth to redistribute it in this fashion, here's a very short story about this at <https://365tomorrows.com/2016/10/06/malia-read-the-paper-and-then-again/>; crowdsourcing projects are completed successfully at a rate approaching 90% <https://digital.hbs.edu/platforms-crowds/biggest-challenge-future-crowdsourcing-business/>; distinguish between merely crowdfunding, and legislation to allow crowdfund investing (e.g. JOBS act), to spread wealth you also have to democratize investment opportunity and profit participation for individuals investing in companies; the most effective way to reduce concentration of wealth is to promote social enterprise or cooperative type Kickstarter crowdsourcing; gives the opportunity to invest in capital intensive or high potential opportunities that would allocate substantial wealth across many contributors; the democratization of the tools of production, combined with the scale of society and increasing amounts of increasing free time, will stimulate more and more people to contribute to projects; increasing numbers of people will become part-time investors—not just in traditional stock markets but in direct investments into individuals via crowd-sourced Kickstarter-like systems.

Decentralization in its many forms, plus crowd funding, could reduce the concentration of wealth, because new wealth can return to public investors; crowd sourcing is a good way to fund popular causes (environment, emergency relief, new start-ups, etc.) but less so for funding unglamorous but still necessary tasks (road maintenance, law enforcement, corporate buy-outs, etc.); a "new order" would be implemented after the collapse of the present debt-based economic growth; the goals should be to increase the amount of wealth in society, rather than to reduce the concentration of wealth as concentrations are inevitable unequal talent and incentives, policies to deliberately reduce the concentration of wealth will also reduce incentives to apply personal energy to solve a problem that results in social benefit; the concentration of wealth is a direct result of the capitalist mode of production; charity and philanthropy will not change the logic of accumulation trajectory; it would increase productivity of some kinds but as a tool to distribute wealth it will not bring grand impact because it would not interfere in the mechanism of wealth concentration.

Suggested Action 2: Create personal AI/Avatars searching the internet, accessing markets worldwide, and making smart contracts to support self-employment.

2.1 How effective?

This seems inevitable, if everyone is connected to the Internet by 2050 and the population is around 9 billion, then everyone will have access to a 9-billion-person market of which one's AI should be able to find enough people to pay for what you are interested in doing; small business is currently burdened by bureaucracy, having AI find

appropriate opportunities and smart contracts can simplify current burdens; expect some positive effect on individual empowerment; seems better for the customer/buyer than to the supplier; good in the short-term but long-term could concentrate production making it difficult for small business; unintended consequences will occur just as the founders of Facebook did not expect that their invention would become a vehicle of geopolitics; lack of personal contact and distant markets are interesting for some, but not very effective; websites facilitating independent gig opportunities exists, but increasingly it will be hard to compete with highly skilled people from India able to charge low prices.

2.2 How feasible?

Accelerating technological development and relatively low sociopolitical barriers makes this course of action very feasible; already on its way; seems inevitable; people from around the world using the platform will be the challenge not the technology; people acquiring the needed skillsets is challenge; interdimensional living may be more common by 2050; regulatory adjustments will be needed to work across borders; local regulations can be a barrier.

2.3 General comments:

This is a brilliant (and marketable) idea to help set up business between self-employed people and those with extra work that needs to be performed; this is one of the viable ways in which new technologies would create new conditions for self-employment; personal AI/Avatars will augment our intelligence guiding and assisting us throughout the day and finding interesting opportunities while we sleep, searching the semantic web for the most wonderful self-fulfilling activities with income possibilities and present them each morning as an array of exciting experiences to fill the day, since everybody (way before 2050) can connect to nearly everybody and everything around the world, AI/Avatars using smart contracts make it easy to create new work and barter opportunities that are exciting and develop one's potential; will be achieved by the proposed date; my own AI/avatar would provide me more choice and better insight into opportunities that I can pursue as an individual or as an entrepreneur leading an organization; the challenge is how to make such a system accessible to all; any activity that can make global markets more efficient is welcome; very useful for marginalized people and economies; effective way to expand access to goods and services; great for computer-savvy individuals who aspire to be entrepreneurs, but what about the rest of the population; unless the education/apprenticing/experience side of it is addressed, such AI/avatars will help the already more capable find self-employment worldwide, so it might not have a significant impact on overall self-employment worldwide; this could be an option, but productive work can't be programmed so easily; for small pieces of straightforward work, this could be very effective and technically very feasible, however, many, if not most people who leave a workplace today do so because they don't like the person they work for, many people who work for themselves do so because they find it difficult to work for others, or others don't like to work with them, so the real value of an AI/Avatar will be if it can match people who like to work together.

Suggested Action 3: Create new labor unions to link one-person businesses to guarantee workers' rights in self-employment.

3.1 How effective?

There is a need for some kind of collective bargaining mechanism for self-employed who are unfairly being taken advantage of by employers who choose to use self-employees labor so that they don't have to provide normal employee benefits. Legislation already exists, but it may not be adequate, as might also be enforcement thereof; Uber drivers complaints are likely to be better addressed if they organize into some kind of labor union; as one-person businesses constitute a growing form of organizing labor this may be very effective in guaranteeing workers' rights, but will it take place; this might be effective in some industries, as it appears to work in the movie industry, but most labor unions are more at raising wage rates than protecting "workers' rights;" collective bargaining with machines is a mind-boggling possibility; wouldn't labor unions contract individualization of the self-employed; effectiveness might be low, due to high fragmentation and dispersion of professions; IT era industries will eliminate the trade unions; governments should already set up the processes for covering new forms of work to address income inequality and uncertainty, and to promote self-employment and SMEs.

3.2 How feasible?

Difficult to get independent-minded self-employed to agree on what and how it should work; not enough commonality of interests; hard to achieve compromise; European unions are too weak or too self-protective to appreciate the development of new labor unions; hard to find enough powerful ambassadors for this world-wide solution; would not work if it increased pay more than the market would pay, unless it helped work quality assurance; private initiatives may succeed; maybe redefinition of roles of human effort and capital will emerge; perhaps solutions may be found through advances in complexity the new science of network complexity.

Suggested Action 4: Establish Labor/Business/Government Next Technologies, Future job skills, retraining Databases.

4.1 How effective?

Job predictions should be made by the businesses themselves, they will know what they need for what is coming up, what training will be required, and will also know pretty well when jobs will be obsolete next; such programs are necessary, and we can see them emerging now; transparency will help; information about prospectives (future possibilities) would ease making choices; previous job market forecasts have been miserable; would be surprised if any nontrivial predictions turn out to be true.

4.2 How feasible?

Something in this area is already being developed; once the idea is clear, businesses will see it as a good recruiting tool, and labor unions could see it as continued income from keeping people employed without lobbying to keep old jobs active; will work best if the focus is short-term and most efficient if government, business, labor, and education

can collaborate on who pays for which type of basic research, basic education, and short-term needs for learning new skills; too much control in too few hands; incorporate VR enough to actually allow the trainee to acquire the ability to apply the materials of the training; not be too hard to establish the databases, but hard it sufficiently used and keep it up-to-date since time is needed between gathering information, creating implementation plan and realizing it; effectively defining jobs is quite difficult, competencies needed (supported by assessments) could prove to be more effective; job demand disclosure should be mandatory.

4.3 General comments:

This is a great suggestion; this is one of those self-evident 'no brainers'; I am working on one of such databases for Brazil; should be an online collective intelligence system that lists new jobs coming up in 5 or so years, each listing the training requirements entered by employers; the databases can present the curricula and skills required; anything that helps the retraining or re-education of workers in obsolete jobs will be a very important; databases with advanced re-training process won't have a significant impact by 2050; learning new skills while in employment is critical; can be very effective as it puts the responsibility on the individual; most effective means to go hand in hand with technological development, especially in countries not so advanced; could be particularly helpful for older workers and those who are hesitant to strike out on their own.

Suggested Action 5: Develop individual augment genius apps (as glasses augment eyesight, genius apps would augment the brain's performance and information).

5.1 How effective?

Would greatly facilitate the integration of people who are not naturally tech savvy into the tech age; anything to augment brain's performance would be an asset for those having access; insight seems more important than performance; augmenting perception and training individuals in how to use such additional information effectively will increase performance, but genius will continue to reside in the wetware; very beneficial for senses, skeptical for brain applications; likely resistance to perceiving this as brainwashing; it's happening and will be effective for those who have access, but will likely also add to digital have and have-nots divide; could help understand self-awareness and patterns of emergence of self-awareness in computers.

5.2 How feasible?

Elon Musk is already hiring people to do this now at: www.neurolink.com, and assume military research has been developing this for the future soldiers for some time already, but we need to think about how prevent future conflict between the augments and non-augments; this is only a matter of time, although the question about effectiveness and measurement of augment remains; it is very feasible since it is a natural consequence of development of IT—enhancement of human intellectual capabilities; most applications are technically feasible, but for a long time will lack the necessary

smoothness to avoid or reduce their burdensome usage; it's feasible as health based on ICT is a top domain, but I am not so confident in the capacity to spread among people and to become a "natural" treatment; this will be determined by the market.

5.3 General comments:

AI applications are happening in real-time, no need for intervention as entrepreneurs will identify all opportunities; since the world is getting more complex, demanding a more educated intelligent public, not just for work, but how we live in the society, being augmented will make life easier in such a sophisticated future, yet education around the world seems way behind needing something like tech augmentation to catch up; it's absolute a great thing, but the user friendly environment about the apps is the most important thing to take care of; the main problem with this type of brain-machine interface is the rate of data transfer—it is very fast for computers, but very slow for the interface between the computer and the brain, I haven't seen any indication that the technological breakthrough improving this will happen any time soon; one can already see this coming with AI as a major step in this direction; any real external augmentation will take a very long time to implement, if indeed it ever is; it's a delicate theme as it can correct blindness but it might also "assimilate" a person.

Suggested Action 6: Labor unions focus more on maintaining income than keeping specific jobs by helping transition from obsolete jobs to next employment and initiate an "Augment Movement" to invest in technology to augment rather than replace labor.

6.1 How effective?

Focus on income maintenance vs. job maintenance is a good one, otherwise we will end up financing redundant processes; some tech will replace (repetitive drudge work); some tech will augment (decision making brain work); for the first time technology is replacing, not augmenting, labor; very effective in collaborative work economies, but not so in the less collaborative ones; if labor unions survive until 2050, and will do this, that can only benefit the workers; some forms of organization of employees will remain but they will be functionally very different from the institutions called trade unions.

6.2 How feasible?

People are resistant to change, employees join a union so they don't have to change their profession—profitable professions don't need them; acknowledging that this change is necessary is the first and hardest step for unions; this could be easily done, if unions can obtain high credibility; you cannot regulate innovation and if you try you will destroy your economy; many unionists are skeptical, needs change management and education; the incentive for most union officials (if not members) is to hang on to obsolete jobs for dear life; obsolete structure with obsolete interest might prevent this; this could work without unions for people willing to change their career.

6.3 General comments:

Promoting man/machine cooperation makes sense. Why must humans become more machine-like? Or machines more like humans? Wet ware can never match computers

for speed or raw processing power. But why devote man-years to developing AI systems that merely mimic the imaginative and instinctive potential of humans, when we could instead strive to make humans and AI systems teammates--more like horses and humans used to be than the pitiless mechanisms and frantic machine-tenders that came into being with the Industrial Revolution? Instead of devising robots and AI systems that are specifically intended to replace human workers, let unions, government, and academic/ business R&D focus more on developing tools that make humans better at the things they already do well. This might cost more and take longer, but the results would be both sustainable long-term and comprehensible to people everywhere.

ILO has its 100th Anniversary in 2019, a great time to have them help the whole world re-think jobs and the role of labor unions, contact your country's ILO office and see if they are taking advantage of this great foresight moment or are they going to just do more of the same; the very idea (and the role) of labor unions will have to undergo radical transformation by 2050; how many jobs will be lost and how many will be created in this "augment movement;" unions have put the financial interest of the employees ahead of the productive interest of the organization, I do not see that cultural change occurring in the next 30 to 50 years; this requires a new generation of unions or replacing their need through the development of social enterprise or cooperatives (where the unions are not needed).

Suggested Action 7: When financially sustainable, implement a national universal basic income system.

7.1 How effective?

An absolute necessity in an era of real change in the job market, as Milton Friedman noted it will save taxpayer money and increase freedom by eliminating large portions of the constipated welfare bureaucracy; this would surely be better than giving out social benefits, which might be a plausible alternative; create alternative cash flow projections to what assumptions and start times are possible; social balancing has been in place for years in affluent countries, such as unemployment subsidies, it will simply be reframed effectively in order to counteract transition to AI based labor market; this idea seems very plausible when extrapolating the current tendencies for reasons such as guaranteeing the income in the era of automation, sharing the wealth, and creating basic demand for the products of robots; it seems like a decent stop gap until we have shifted into post-extraction financial systems; would be very effective in establishing a more sustainable working life; it depends on the level of development, since this requires a higher level of values to work, like the spiral dynamics model or PROUT kind of approaches; the problem is not the cash flow, but the present political and economic model, as well as the general consciousness, a basic income guarantee would set people free—unleash creativity and eliminate income insecurity, which would undermine the present socio-economic model, hence, there is and will continue to be a huge resistance to it; it's the road to financial disasters and subsequent civil wars, paying people for setting aside could be devastating for any society.

7.2 How feasible?

All depends on serious alternative cash flow projections showing under what conditions it is sustainable; many forms of at least partial sharing of wealth will likely emerge, Sweden, Germany, and Norway have related basic income systems as a net of social benefits; timing of activation depends on the economic conditions of a country; would have to be carefully and wisely established; may help social stability for some time, that may be needed; any government has the right to create money and if tied to asset-based crypto (connected to necessary infrastructure buildouts) this can provide UBI; not very likely to happen, since too many actors have few or small incentives to be part or sustain the implementation of such a system.

7.3 General comments:

This will have to happen at some point, otherwise rising unemployment will lead to social instability and social breakdown; UBI would be one of the several ways to bring in an element of equity in society, although the Indian experience with implementing a minimum wage law has been a mixed one, it does not detract from its desirability; a new social contract will need to be established between the "haves" and the "have-nots;" an ideal to work toward for sure, but implementation on a global scale will demand much rethinking of "basic" needs, what makes a good, decent, secure, and satisfying life; sounds great in principle but I haven't seen a single study that shows the arithmetic adds up, payments would have to be very modest, although something is better than nothing; this is vulnerable due to short term governments especially in the developing world; what would it mean in the EU, would standards of living be equalized, what about the differences between countries and regions, will it be possible for Africa to create hundreds of millions of jobs, this will demand a new political and maybe even an ideological background; will it be implemented evolutionarily or revolutionarily, revolutionary attempts of equalization failed; the main pitfall is that sometimes the social minimum becomes the effective maximum, an ideal labor space would be one in which the most vulnerable are protected, while the rest are able to compete, it is not clear whether UBI will fulfill this; the basic income incentives encourage laziness; it depends totally on how it is implemented and funded.

Suggested action 8: Put memes in advertisements to help the cultural transition to new forms of economics and work.

8.1 How effective?

Effectiveness is determined by what memes are selected and how they are delivered; using artistic catalytic symbolic work may help for a collective transformation of consciousness; we definitely need a ton of new stories, memes and stories can create momentum even in an infobese (information overloaded) world; communication and storytelling have always been effective in supporting change; how to avoid being propagandistic Orwellian, memes will get drowned out in the competition for people's attention.

8.2 How feasible?

It's already happening organically; if the Advertising Council in the US and the equivalents in other countries took this on, it would be successful; although a small technical proposal it could be feasible;

the memes are already here just put them in the ads; given present social media brainwashing unfortunately it has a good chance. Disgusting!

8.3 General Comments:

As genes make the body, so memes make the society. What kind of society do we want with all this new tech? Then let's get the memes for that society in the entertainment media and advertising agencies. Memetic engineers should be hired by advertising companies to insert memes in ads to help the cultural transformation while selling their products; This would appeal to the younger workforce, and also would be feasible across national and cultural boundaries; the creation of awards would foster it; it takes about 25 advertising impressions to move a person to act; if the new forms of economics and work are practical, people will embrace the new ideas through more conventional education and training channels; subliminal advertising may work, but is it ethical, opponents can easily counter by planting their own memes and suggestive images in media, the whole approach seems marginal at best; a tree was a seed first; one step today, one step tomorrow, 2 steps in 2 days to the goal.

Suggested action 9: Establish something like a “World Billionaires Club” for global strategic philanthropy specifically to address income gaps.

9.1 How effective?

If they were strategic in coordinated investments, this could be very effective. Since several of the new billionaires belong to the digital Era that may help; but it is already here! Look at the tycoons declaring how much of their wealth they devote for philanthropy; these activities lack in accountability, transparency and also longevity; in order to be useful they should be working all together, does not seem very likely; counterproductive, since confirms the false idea that wealth is a cake of definite weight and cutting more equal slices is the solution; more effective to create new money rather than shifting old debt based money; the sums involved would be nowhere close to what would materially reduce income inequality; addressing income gaps is not on their agenda.

9.2 How feasible?

The Giving Pledge <https://givingpledge.org/> "The Giving Pledge is a commitment by the world's wealthiest individuals and families to dedicate the majority of their wealth to giving back." 183 billionaires have already made the pledge in 22 countries; it is feasible since it is already present. The only question is to which extent it should be institutionalized; it could for sure happen since some billionaires like doing good; being in such a philanthropy club surely looks good, but wouldn't billionaires rather support something more urgent and life-threatening? Establishment of the club - easy, making billionaires donate specifically to reduce income gaps - not very feasible; doubt it will have substantial effect; an XPrize for this would be interesting.

9.3 General comments:

This type of project is what helped to make immense progress during FDR and Eleanor Roosevelt's ascendancy in the USA, it created both practical good as well as a sense of progress and high morale; how to get the Giving Pledge of 183 billionaires to create a coherence global strategy to address the income gaps? Ok, but why a club? is the goal to shame reluctant billionaires into joining; clubs like this emanating from such individuals as Bill Gates and Warren Buffett already exist, but are still vastly overshadowed by conventional public expenditure by government, Income gaps is an issue for government; Focus on new ideas and methods of representing Corporate Social Responsibility; Mondragon is already working with Soros Foundation (OSF) and others on shared ownership business models to reduce income gaps; Very deep cultural resistance and human greed would not end in only two generations; Who establishes a fair distribution system that would enable this goal to be accomplished; is it worth a further weakening of democracy—why don't these billionaires just get into politics, with all the risks that entails? Better question is: Do you think that under the pressure stemming from a more open social life and due to other reasons (which - to be decided), the rich people will feel more pressed to share their wealth (in comparison with the previous eras).

Suggested Action 10: Create a World Cyber Game to explore self-employment and Self-Actualization Economy.

10.1 How effective?

Lovely idea, but will probably not have the reach it would need, might be more of a private business solution; all depends on how good the game is, who would have believed that one platform would have more than half the Internet world on it (Facebook) in just 14 years; good idea; gamification works to some extent; good training idea; very good learning tool; sounds like an idea for a dystopian sci-fi movie; doubtful that a game really has long-lasting effects; as I recall, media studies do not support that suggestion; too much emphasis on self-employment, it will end to generate self-employed stalkers/beggars.

10.2 How feasible?

Technology is already available, easily implementable; cyberspace almost unlimited; the game would have to be adjusted to local and national standards, one-game-fit-all might not be very effective; given present trends in cyber addiction it could happen; all depends on how good it is and how promoted.

10.3 General comments:

Seems a good way to introduce new goals and business methods, especially to the young. The trick will be to make the game challenging and exciting enough to hold players' interest but discourage "win at any cost" strategies and dream-world addiction; it is happening already with a small part of the population of the "Second Life" virtual world; A World Cyber Game is ok as entertainment, building skills, explore self-awareness and is fun so why not implement it; It's a milestone of the e-industry.

Underground group could be able to be the top tier groups. It's best for young people who are trying to find self-identification; language and cultural norms would be a challenge; it sounds wonderful, but I think it would get lost in its own virtual world.

Suggested Action 11: Business leaders should take the initiative to engage with government and others to develop long-range strategies to reduce income gaps and the concentration of wealth.

11.1 How effective:

If this were to happen it could be very effective as is the case with the Scandinavian business-government collaboration; business leaders like Gates and Musk if matched up with a new generation of political leaders like Trudeau could really make a difference; already happening de facto; cooperation between government and business would allow real-life problem solving; this should be ideal, but unfortunately present leaders have not achieved their positions because they wish to reduce income gaps; effective if it drives the creation of opportunities, not subsidies; such social responsibility is good for business; letting go of massive amounts of workforce is somewhat inevitable in the future, the cost of that might as well be invested proactively; concentrate power to diffuse wealth? Good luck with that.

11.2 How feasible?

It will probably come by necessity and the billionaires of the Giving Pledges would be a good place to start; design a win-win approach; feasibility dependent on both side's engagement; this suggestion could be feasible in some contexts, but globally the feasibility is low, some business actors, in some regions or some markets yes, but they remain insular; this would require a change of mind set from seeking maximization of shareholder value in the short term to sustainable navigation through multiple domains.

11.3 General comments:

Business has never historically been charged with this task, but business leaders have greater impacts around the globe, they will be increasingly involved in issues that do not appear relevant today; Mondragon is already doing it showing its own example of a successful large scale cooperative group; corporate Social Responsibility needs to be promoted; it's the core of economic advancement to have collaboration; tripartism should be encouraged rather than single-agencies; with the implementation of universal basic income, gaps and concentration of wealth would assume a very different perspective; it's really governments that should be taking the initiative with businesses; initiatives like this would be very welcome but, business leaders tend to ally with governments to increase their income; schemes to "play the system" are more common motivators especially in super-large companies, still, individual business-people in certain countries may adopt this goal and every individual helps.

Suggested Action 12: Develop ways for companies and employees to create ethical, aesthetic, and social value in addition to economic and material value.

12.1 How effective?

Many companies already have put in place the ethical value proposition, Jeff Bezos Amazon shows this is very effective, these cases are not yet "coordinated" but is an area that could be an area of improvement; companies are expected to do this now—ethical brand value is an important part of how people choose companies to support with their purchasing power; there is a reason why predatory multinationals in Nigeria become squeaky-clean in Finland; next to customer desirability, technical feasibility and business value, social impact is beginning to creep up as a criteria for new businesses; wasn't this part of what labor unions did? at least when unions and employers were not biting each other's heads off, it was very efficient in constructing and shaping social sustainability; minimal impact on work-technology prospects; these values will become more and more important when most of the work will be automated.

12.2 How feasible?

This is already happening and is creating a competitive advantage for the companies that embrace ethical brand value; already doing that with my clients; only need a capable, well-intentioned government willing to legislate the right incentives.

12.3 General comments:

This would not be all that difficult for businesses to pursue, i.e. setting up a process or processes that would allow for greater feedback from all stakeholders, the benefits might hamper short-term profits, but these would be made up with long-term prosperity and increasingly higher morale; the Mondragon Corporation (federation of worker cooperatives) could show how to do it; the Institute for the Future's ethical Operating System is an example; master's degrees are now offered ethical leadership; it's not the role of companies and employees to achieve such things; businesses will not voluntarily 'do the right thing' without economic incentives or penalties; changes need to be made in corporate culture and the values that drive it; sound concept, but minimal impact on work-technology prospects.

Suggested Action 13: Create a legal framework for alternative blockchain and cryptocurrencies to invent alternative economies.

13.1 How effective?

It would open up for many (young) entrepreneurs to explore these economies; it is a very effective tool to implement new ways of generating value and money; biggest problem is the masses do not understand any of it; the idea of cryptocurrencies is based on it being illegal, or used for illegal purposes; the legal entities that would govern it are exactly what alternative economies can begin to replace; may help at the margins.

13.2 How feasible?

It's already happening : <https://bitcoinmagazine.com/articles/cryptocurrency-regulation-2018-where-world-stands-right-now/>; feasible, otherwise the cryptocurrencies will

disappear; it's a kind of self-referential condition sine qua non of development of a new financial phenomenon; the technology in this field is already very advanced; need to coordinate a wide variety of global actors with very different incentives; with proper education this would not be hard to do.

13.3 General comments:

Digital currency and blockchain will probably affect 20% of the world population by 2050, if it is decentralized with no centralizing authority, it has the potential of making a dramatic, positive change; impact of blockchain goes well beyond cryptocurrencies; it is an essential precondition for alternative economies to function in a positive environment; they have been a benefit to organized crime, illicit arms deals, and terror networks hence, a legal framework is needed; blockchain and cryptocurrencies use an immense amount of energy, in less than 10 years all the energy produced via solar power, for example, will be used for blockchain mining, it is an incredibly wasteful process, and is not at all environmentally sustainable given the current climate change context; creating a "legal framework" means subject this marketing to an outside "authority" that wasn't from original concept.

Suggested Action 14: Manage companies like professional networks, rather than as static hierarchies.

14.1 How effective?

More fluid hierarchies are capable of addressing volatility, uncertainty, complexity and ambiguity of future changes in the market; a factor to succeed in the transition to an empowered workplace; many corporations already implementing this business model and it seems to be working just fine; this would be effective and companies that are social innovators are already moving in that direction, however, as long as the governing system itself is managed so extremely hierarchically --as is all the rest of the society -- it is very unlikely that many companies will change; this will increase the gap as the managers will cling to their old ways/values; there is no reason to believe this will reduce, rather than increase inequality.

14.2 How feasible?

Already emerging; happening in many instances; spreading lessons learnt would be helpful in adopting such operational styles/culture; see John Kotter's work on shifting to networked organizations.

14.3 General comments:

The brain is increasingly the factor of production and does not lend itself to the controls required in the industrial age, technology companies operate on a network or mesh basis and not a hierarchical basis which bodes well for this organizational decentralized authority and responsibility structure going forward; new technologies makes this inevitable, can't function as hierarchical static entities; coopetition opens up new perspectives on labor; seek optimum balance between the two extremes, different balance for different enterprises; the increased rate of the rate of change requires the deconstruction of hierarchies; the statistics already showed that this is a key for

successful business; professional networks do not need to be managed they should remain organic systems constantly evolving; business schools still reproduce the static hierarchies; there still has to be some final order, otherwise companies end up as headless chickens.

Suggested action 15: Encourage more businesses to produce experiences instead of physical products; focus more on exporting knowledge than physical products.

15.1 How effective?

We are moving toward the experience economy as projected by Pine and Gilmore; this would cause a shift from manufacturing dominated by automation to human-based business; shifting to local independent production through open source experience could prevent lower income countries from becoming as materially addicted as most of the affluent nations;

15.2 How feasible?

Very feasible in wealthy parts of the world, people that fulfill material needs and achieve given level of wealth, will start to shift towards experiences; already happening with the shift to digital reality; physical products will still play a substantive part even in the future of the knowledge and service economies.

15.3 General comments:

Industry will invent and implement experiences beginning with artificial intelligence and artificial reality; consultancy sector could help on this; travel agencies sell experience, universities sell knowledge and experience of becoming an adult income earner; businesses don't need encouragement to do this, some are well positioned to provide experiences, others less so, but the goal of making a profit and maintaining a sustainable business model seems paramount; be mindful about what the side-effects might be; let the market do this.

Suggested Action 16: Create observatory or horizon scanning online platforms that update employment and technology trends along with discussions of future of employment.

16.1 How effective?

Very effective if widely shared and freely available especially to developing countries; great help for the small minority of people who both use it and have the skills to profit from it; that idea has some potential and I can testify there are already many attempts (i.e. startups) in place, BUT only the brave will benefit, meaning just those individuals already embracing empowerment would be curious to exploit such a resource, while others would not be interested; would have to be highly reliable, but great idea; governments are too slow for this.

16.2 How feasible?

Initial attempts already in place would be strongly supported by AI; if a global network of experts is created, it would have to be highly scientifically-based.

16.3 General comments:

Helping people understand the future, and their options, will be crucial to encouraging the feeling of agency and control in an increasingly dynamic and complex environment; laudable suggestion, such platforms shall be urgently needed to create sufficient space for updating employment and technology trends; free access to knowledge, trends and technologies is very effective for citizens' individual and collective self-development; AI systems should be able to do this with ease, it is critical for the fast changing employment landscape; the Basque Regional Government Labour Agency (LANBIDE) has already developed the FUTURELAN online platform, with the support of Prospektiker; collaborative networks are the best scenario to face the technological challenges towards future decades; how to make it sustainable.

Suggested Action 17: Define a new social contract of workers' rights in a transactional and global economy.

17.1 How effective?

Instead of a new contract between employers and employees, in the future it should be between workers and the market being it B2B or B2C or any other form of supply chain logic; would be great for those workers who have not (yet) been pushed out of the labor force by AI; there is little oversight of employers of freelance workers who are afraid of reporting abuses such as female-to-male pay gap and advancement problems and privacy with social media access; has to be global along the lines of Human Rights even though these are not enforced by the signing countries all the time; AI will disrupt more than anyone can imagine, this is not an effective or efficient way to handle the situation.

17.2 How feasible?

Can support global integration; workers in different countries have vastly disparate, even opposite, interests; strongly needed, but national authorities will always try to manage the matter with excessive detail and national structures of markets and politics will interfere; cultures are the biggest reason this will not work.

17.3 General comments:

I believe the establishment of a new social contract will be initiated in commercial enterprises and spread from there to communities around the globe, the government is historically late on such things; must be done to maintain social stability especially if many jobs are eliminated; the freelance economy is replacing the workers economy and by the end of this century there will be no workers; would definitely raise the status and self-respect of workers to the great benefit of all societies, but how to implement across borders; differences between wealthy and poor economies push this far in the future; there are local cultures that have their own forms of self-organization that need be respected; difficult to do since unions "sectional interest" first as opposed to the general interest.

Suggested Action 18: Strengthen corporate social responsibility including addressing UN sustainable development goals, countering information warfare, establishing smart city security, and developing ethics of AI and synthetic biology development.

18.1 How effective?

Corporate Social Responsibility (CSR) has become the norm for Millennials, they study it at the university and its implementation is expected, CSR's spread will impact the future of work; if CSR was really strengthened and made more strategic it could be very effective; if the measure of performance would shift from 'profit-by-all-means' to helping progress on the SDGs, and/or a 'SDG-compliance' label would be mandatory for all companies' products and services leading companies to change practices, but there had to be definitions and measures of CSR with serious rewards and punishment systems; ethics and income should be equal goals, as people's income increases they will care more about the ethics of what they buy, how it was manufactured, where the resources came from; somewhat effective in principle but then actual implementation of these kinds of initiatives is generally cumbersome; with AI and AGI pushing the boundaries this is absolutely necessary; not sure what this has to do with work-technology prospects; most corporations only pay lip service to CSR.

18.2 How feasible?

Already happening; it is feasible as a result of natural evolution of society and as long as consumers put pressure on corporations; individual responsibility is the real trigger to start from; legislative changes are required to make this happen; there are many ways to achieve this goal, here is one very interesting channel:

https://www.academia.edu/1206001/NUDGE_TOWARDS_CORPORATE_SOCIAL_RESPONSIBILITY)

18.3 General comments:

Corporate social responsibility will increase as it becomes more and more apparent that the human factors of production requires the use of productive brains to accomplish the objectives of corporations; start with encouraging more ethical behavior by individual business executives and their staffs; the benefits here seem incremental, but over the course of decades this will have a strong effect; a top down approach will be valuable for encouraging a rapid development in this direction; there would have to be an enforceable legal background for such a development to work; much depends on tools to strengthen CSR and making corporations accountable, it is not that the suggestion is not feasible—but the way the governments and corporates have often addressed these issues leaves a gap between intent and performance; if population monitoring as being introduced in China spreads to other countries including smart cities, it will generate counters to monitoring putting AI at the disposal individuals as well as governments, corporations an interesting set of CSR options; AI and biological development demands some protocols to protect human integrity, and monitoring public and strategic stations are legitimate; mostly western companies are affected by this, China and other Asian companies do not care and they will rule the market in the future meaning this initiative

may get lost in the pressure of market forces; consumer will decide who to do business with; I don't want a world run by corporations; companies are independent entities and should not be burdened with social responsibility;

Suggested Action 19: Business schools should teach synergistic intelligence, advantage and strategy as well as competitive intelligence, advantage and strategy.

19.1 How effective?

Schools should teach up-to-date knowledge that concerns teaching strategy and synergistic intelligence and future thinking in any school; synergy is a step beyond co-competition; of course it should be taught at business schools; any higher education should teach collaborative and synergistic approaches; business schools already do this; not sure there will be business schools in the future.

19.2 How feasible?

Many decision-makers are focusing only on competition instead of exploiting the value of co-competition (synergy is a step beyond co-competition). In my experience, most of CEO's and the like are self-centered workaholic males (a lot of orphans among them, for instance), passing more control and responsibility to mothers would help the transition a lot; already implemented by leading business schools; higher education needs to make this shift across all departments, not just for business schools, this would be more effective preparation than people get now to address global challenges; the problem is that much of higher education operates on the basis of exclusivity (what is special about our school) instead of on the basis of adapting to changing world conditions; business schools are a thing of the past.

20. Additional Suggested Actions: What other business and/or labor strategies would better improve work/technology dynamics by 2050?

- Focus more on business women's issues (affordable and trustworthy childcare makes the greatest difference for women's ability to join the workforce effectively; training (including higher education) that is focused on older workers helps women to maintain their vision of a strong future past childbearing and raising; etc.)
- Establish a global economic institution that gives ratings to companies for favorable employment and labor practices, sustainability platforms, anti-corruption practices, and other social platforms to fight hunger, unemployment, protect human rights, job training, community efforts, etc... Favorable ratings give companies better credit scores and easier access to loans.
- Promote collaboration synergy between diplomacy and entrepreneurship; diplomats will be helped to implement their mandate and entrepreneurs will be supported to develop their business.

- Promote initiative, curiosity, innovation, moral judgment and focus to be more motivated and compensated for contributing skills to the benefit of their community.
- Avoid concentrations of power through constitutional rights, direct democracy, federalism, and large-scale wealth redistribution
- Limit the concentration of wealth; after a point wealth is not about needs or wants, it is about power; it is un-elected power; and therefore, dangerous.
- Pay more attention to specific technical issues than to ideology.
- Promote responsible public procurement by governments.
- Foster co-opetition because this collective strategy allows for the creation of bridges between different and complementary active sectors, which is a source of innovation in the field of Work and Technology.
- Change the concept/definition of business to include all value-creating endeavors.
- Support freedom of labor movements internationally.
- Develop Nudge (https://en.wikipedia.org/wiki/Nudge_theory) as a policy approach
- We need to study those issues in more detail.
- Long-range goals and planning should be encouraged in business and throughout society. Workers should be recognized and rewarded in meaningful ways (e.g., fame) for their actual skills and accomplishments, not just their titles or the money they bring in. Business should be encouraged to adopt new measures of success that include sustainable benefits to customers not just return to investors. Continual growth is inherently UNSustainable and should be abandoned as a desirable goal in business as it is in nature.
- I'd envisage a quicker and easier access to micro-credit and crowd-sourcing to help narrow-scale startups. We've to give to any empowered worker the opportunity to develop a sound business idea without discrimination because of academic background. For instance and just to brainstorm, why don't we plan to provide pro-bono support for setting up business plans such as it's granted for a litigation?
- Encourage labor to have a louder voice in determining the future.

- Create business models remembering the importance of human solidarity.
- Establish a range of minimum and maximum income
- Forbid and prosecute tax havens
- Establish and protect partnerships with commons-based peer production
- A thematic free online library where anyone interested could access samples of how to develop skills of the most visible promising jobs, through courses with videos-lessons, texts and web-relevant-links.
- Focus on collaboration of humans and machines.
- Add entrepreneurship education starting from the primary schools. We need people prepared to make business and to reduce the fear of failure as well as to increase the status of entrepreneur in society.

Parting comment from a participant: Thank you, Millennium Project. Great Job.

Culture, Arts, and Media

Suggested Action 1: Establish national advanced public/private research centers to explore the kinds of cultural change needed to address the future work/tech issues and how arts and media can help achieve such cultural changes.

1.1 How effective?

Research centers are good places where innovative ideas usually arise, so these could be good environments to rethink cultural changes for a future world; The USA workshop in Washington suggested a DARPA-like agency for culture (Defense Advanced Research Project Agency); DARPA is good example, not sure which one in UK, maybe NESTA, DSTL; Culture is a crucial prerequisite to be able to effectively make the necessary changes to address future work/tech issues; in a broad sense social change is always 'cultural;' mixed structures/facilities would work; they should be somehow connected with advanced companies; having an official outlet that dedicates its time on preparing for the future will have an audience; think tanks explore cultural changes as consequences of transhuman technologies; will take multiple generations unless there is a cataclysmic event that necessitates that change; such exploration should be done on an ongoing basis; local centers would be more effective than national centers in reaching citizens.

1.2 How feasible?

How do we get past all the noise in the mixed-intentioned media to get the message of the results of this agency's research to enough people to make a difference; just a

question of the will and leadership to do it; easy to add as a role for national arts institutes to play; it will help understand the challenges that we are facing; there is enough interest in the future to create it and can be done with minimal funding, yet longevity will be based on actual impact of its work; change of culture in general is not an easy task; justifying the funds to do this might be a challenge.

1.3 General comments:

Media and entertainment are early adopters of technologies and are already influential in presenting how people will, do, or have used technology (plots in movies, games, plays, and descriptions of how children play with toys are all part of this); The number of NGOs focused on this grows (e.g., Croatian Cluster of Creative and Cultural Industries <http://en.hkkkki.eu/>); our university is precisely starting right now this kind of public-private partnerships addressing this topic; in Turkey the center should be independent of the government, ruled as a NGO, under the protection of an international organization; to seriously generate research and multidisciplinary knowledge to address the new challenges of the future it has to be independent and overcome individual and political interests; a multidimensional network of private research centers plus one or more virtual centers is needed for Korea; while the Millennium Project is a good example of such an effort, work at the national level is significantly more resource intensive—so the questions are: who understands the need; who can effectively make decisions, and who can then efficiently implement chosen cultural changes; cultural change is either a multi-generational process or it is forced/imposed upon a culture(s) by external and/or internal force; establishing a national center will take at least 15 years to reach level of productivity that will be needed to affect change by 2050.

Feasibility of this varies widely worldwide; too few in my country would be able to understand how these two things are even connected; communicating through hand drawn animations is a very useful tool to reach a broad public at once; consider tourism's role; cultural and creative industries have become major factors in national economies; since 2000 arts and media are very powerful in creating daily life around the globe; need for cooperation among these centers; very important to make synergy of cultural values to support peace and development; well worth attempting, but avoid big investors who care more about censorship than in transformative stories and images; this can be very effective, but can be easily corrupted; there will be cultural barriers for implementing the cultural shifts; this type of project requires a champion; people will start making statements through relevant arts of their own volition; not sure that a research center would be a modern mode of institution for a task like this.

Suggested Action 2: Work/Tech future-oriented people should work with celebrities, writers and content creators of TV, movies, computer games, music, immersive media, and emerging media technologies to get new ideas into the culture like potential cultural impacts of Next Technologies (NT) such as expanding the purpose of work from survival/livelihood to self-actualization.

2.1 How effective?

Science fiction writers, movies, and advertisements already do this; consider the values communicated by Star Trek; music was the driving force in the USA of the 1960s “cultural revolution;” a leading US figure spent time with the song writers of the Jefferson Airplane and others to get public attention to new values; music, television, literature (Timothy Leary and Baba Ram Das with their books and public speaking about LSD promoted on TV and in music) made that cultural change phenomenon happen and now the medium of the internet is affecting many for good and bad; hearing celebrities talking about the meaning of life, work, and technology would have a very positive impact; celebrities reach wider audiences; they are cultural attractors; this is already happening but not yet widespread.

2.2 How feasible:

Easily done through networking; celebrity actors and other entertainers already routinely become engaged in social and political issues; find those who are particularly sensitive to the issues of the future Work and Technology 2050 so that they truly engage in this; shows like "Ann With An E" and Dick Wolf's attempts to raise social issues of the day thru his Law & Order and other franchises and some of Steven Spielberg's movies are some examples; the artistic community as a whole has played this role for a long time, but get the right persons and provide them with good information; it is difficult to think of who would pay a celebrity to advertise the need to dissociate work and income; with the right people it is very feasible, but today's world is far busier than the 1960s cultural changes in the US yet we now have far more means of communication.

2.3 General comments:

We need to give the audience an extension in every TV episode while tying the pieces together from one episode to the next like Big Bang, the very popular TV show has done for science—it has probably taught more people about Schrödinger's cat than physics professors; TV soap operas in India are used to encourage more developed attitudes; We need people like Neil Degross Tyson who can communicate future ideas, we need to show the current sponsors and producers that these steps will attract an audience; work/tech future people can become these types of people and vice versa; work with organizations like Hollywood, Health and Society at USC, CA and also Participant Films, Science and Entertainment Exchange, The UN Foundation, etc. The Entertainment Industries Council www.eiconline.org does great work along these lines; working with cultural change through popular culture itself is a very promising approach to self-actualization; Assoc. of Professional Futurists APF chose an education futures study as a 2017 winner which includes a range of change strategies in this area; this approach is common worldwide, but not yet focusing on the long-term future work/technology issues; we should look for the future-oriented initiatives and ideas to come from the younger generation rather than from the already established writers, content creators etc.; AI will transform the role of entertainment in the future; we need next gen human-centered empowering science fiction like: <https://doteveryone.org.uk/women-invent-the-future/>.

One of the roles of the arts is to expose the public to alternative ideas, and the idea of a post-work world definitely needs to be promoted; this must also be taught in schools, with new, continuing education through TV; what we are talking about is a revolution in mindsets and attitudes; needs to be an all-out reinvention of human nature; I would support an idea of intensified multifield interaction; collaborating with pro content creators can uplift the quality of the messages and the impact; this could be very effective, but unless there is a universal basic income, people may feel patronized; connecting innovators and communicators should drive the public will, but so can counter-minded groups of people—like the anti-science people; media and communications are in the hands of the few and need to be expanded; I fear many artists and most sponsors would still rather give people what they want to see rather than what they need; this is a static vision and a manipulation of people without an actual engagement of the people.

Suggested Action 3: Art schools, ICT professionals, philosophers, others should be encouraged to develop the means (e.g., experiences, arts, media), that can help the healthy transition to cultures that increasingly blur the perceptual differences among virtual, physical, and augmented reality.

3.1 How effective?

Agree that art schools, ICT pros, and philosophers developing the means to facilitate engagement between AR, VR, and physical realities, but am not sure we should be blurring those differences lest we get lost in and lose mental abilities like with the use of calculators in schools over the past decade, kids can no longer do math in their heads. Also, the link between art schools and ICT pros and philosophers and business needs to be strengthened for this to maximise the level of impact. This will allow everyone to learn the many realities that will exist in our environment simultaneously.

3.2 How feasible?

World is moving in this direction; begin with pioneers and others will follow; I think these groups are interested in supporting these types of initiatives, all you have to do is keep doing what you're doing with the kids in first and second grade—the color palette, styles of artistic expression, etc., keep teaching this all through their K-12 education, children have eidetic minds anyway, so just keep on supporting that; it is feasible but necessary to articulate "different and new" forms; the links and connections already exist, much is already being done with this, and there is economic incentive to do it because it will expand the market for VR and AR products.

3.3 General comments:

We are entering into an era of co-evolutionary symbiosis, in which the boundaries between the virtual and the real, the biological and non-biological domains of existence perception and functionality not only become "blurred," but irreversibly inseparable, by necessity; even now, the scale, velocity and parallelism of sensory and contextual information processing is rapidly accelerating into domains of existence management and interaction for which there is no previous precedent in human history, the symbiotic merging of the virtual and the real will become the accepted norm rather than the

exception, what appears to be somewhat novel examples of current interrelated technologies of the moment will become a ubiquitous co-evolutionary ecosystem, emergent features of this accelerating new norm will become apparent as artefacts of behavioural epigenetics; we need to bridge the gap between the digitally literate and illiterate; it must be a part of every television sitcom and news show.

Art schools and engineering schools produce the product designers who are already designing the human-technology interface, they visualize the future of how people will work with futuristic products;

See USC Hollywood Health and Society and the UCLA's Skoll Center for Social Impact Entertainment <http://www.tft.ucla.edu/skoll-center-for-social-impact-entertainment/> for case studies; my work on developing VR, AR, and immersive arts is showing me many possibilities, but blurring the perceptual differences, also could manipulate people's perceptual realities—think MATRIX; the market will drive these changes, but without much integration; these transitions will happen slowly and gradually; preferring virtual to actual reality can often increase isolation and despair; waste of resources as not focused on real issues; the blurring of perceptual differences between realities will guarantee the end of the human species.

Suggested Action 4: Produce movies, music, TV shows, computer games, and immersive media with more positive storylines that portray how the culture of augmented humans could evolve without prejudice and conflict with the non-augmented humans.

4.1 How effective?

Movies, music, etc. plant the seeds of what people will believe tomorrow; stories are the programming language of culture; this seems a valid way to start the movement; understanding a variety of human augmentations including physical augmentations like artificial hearts and legs, as well as performance drugs, and eye glasses can be used to help bridge the gap, and might get people past what they see as sci-fi alteration of humans; think of the French film *DEMAIN* of Cyril Dion and Mélanie Laurent and its impact on our perception of the future.

4.2 How feasible?

Only the will to do this is needed; depends on leadership—who will give the leadership for this; the question is whether a government agency or politician can effectively lead artists and cultural leaders to create stories and content; the non-digital and non-physical augmentation of humans is already being done through meditation and other religious practices and needs to be encouraged through positive media of all forms.

4.3 General comments:

Definitely worth the effort, and it certainly should be done, but we need to start really early, infuse it into how we bring up children, and create social-political-cultural structures that support more egalitarianism; the biggest challenge around this approach in fictional storytelling is the inherent need for story to have dramatic structure—conflict and a protagonist and antagonist. We could, however find ways to team up the

augmented humans with non-augmented to fight other negative forces vs. vice versa; many games and movie producers will welcome such narratives, creators can enter contests for their ideas to be funded; government arts councils could give awards content, but creatives cannot be dictated to; much innovation has been presaged by the minds of sci-fi writers, screen writers, and artists of all art forms, to what extent are we including in the "augmented humans" category, persons who have gained what are considered exceptional abilities through Yoga and other religious practices, as well as with physical technology to which everyone should have equal access to reduce future prejudice and conflict; show how culture can evolve with human augmentation as a form of self-actualization.

This is critical optimism, as distinct from media populist negative narratives that the world is worse every day, this is not true, and we need to change this collective mentality of negativity to a positive and reflected one; too many games are just about warriors, not about statecraft, we need to emphasize statecraft as much as we do warrior-ism; point out the challenges and alternative ways forward, not just promoting a technologic future; augmented humans must be taught during their childhood schooling and throughout life to consider those who have been left behind; without digital augmentation we are dead as a species, since eventually, we will have to leave this planet.

Suggested Action 5: Develop altered states of consciousness Art to imagine new futures of work and technology including merging human beings and technology.

5.1 How effective?

Small numbers of people would get this, for them it would be very effective; not for the masses, but visionaries across cultures have always done that and continue to do so; include meditation, prayer or similar methods; create alternative scenarios to provoke action; designing futures from the imagination is very important; it is those who tend to fall outside of the normal states of awareness already who see a future and then go on to create it, there are already many non-drug or physical implant means of entering altered states of consciousness, and these should be encouraged and explained so that more seek to take advantage of them; this may also be dangerous and have negative effects on youth (escapism, autism, isolation, and aggression).

5.2 How feasible?

Variety of efforts are available, but may cause suspicion from the public or authorities; Certain groups of experimenters are already trying such things and many more will try, in this time frame, I think it will still be somewhat experimental; very challenging on a massive scale; public opinion will be hard to change in just 32 years; very feasible but unpredictable consequences for mental health; not easy for the masses.

5.3 General comments:

Isn't that already being done much more than most people realise? Maybe it needs more positive emphasis in its application; experimenting with merging human beings and technology, why not, people have always explored altered states of consciousness

with a variety of means such as substances, meditation, and technology; a good theme to explore; human/AI partnership (as an alternative to AI/robot replacement of humans) does deserve consideration, but artists and educators will need wit and logic if they are to persuade the general public to seriously consider this alternative; feasible when launched from an all-encompassing scientific launching pad; too radical an idea for us to be able to grasp all its implications right now; could be very powerful, but I do not necessarily recommend this for everyone; art has always been the laboratory of the future where people and societies have been able to experiment, demonstrate, make tangible, reflect, and bring awareness of novelty among societies; music videos, art, stories (especially science fiction), comics, plays, etc. are all able to embed these types of storylines into their narratives, immersive VR, fulldome, and AR are new ways to deliver these stories that feel more like an "altered state" than more traditionally delivered media; reading a book can alter your state of consciousness; studies already show that Virtual Reality enables people to see how their actions affect other people and the environment around them; this could be very feasible, but do we really want to do it, better to have conscious humans separate from the machines so we can pull the plug when necessary; it is very difficult to imagine how future work and relationships will work, even in current times, merging humans with their technology will be seen as creating a monster or fearful beings who might hurt or destroy those they replace; this will happen in some measure naturally, I don't think it will have a big impact; more escapism from real world situation of humans on a warming planet.

Suggested Action 6: Public/private research should explore the cultural transition for a new social contract between the government and the governed, who potentially could be both unemployed and augmented geniuses.

6.1 How effective?

The social contract needs to be revisited for any future in which people are free to constructively pursue whatever they chose in life, and part of the contract will have to be a major cultural transition from the work-ethic based on more open alternative life styles, including the unemployed and non-physically augmented geniuses; it is obvious from recent elections in most countries and rising social movements that there is a disconnect between what government's think they are doing and what large segments of citizenry thinks government is doing or not doing for them. A review of the social contract is overdue; forecasting future prejudice/conflicts is VERY important so that we can think of how to prevent or reduce its severity; very desirable because of the assumption "shared" by the whole of society; new social contracts should also consider a planetary perspective beyond national boundaries.

6.2 How feasible?

Using the arts and futures groups such as this one to promote it, combined with public and private think tanks and other research organizations having competitions for research grants combined with private sector participation in the implementation of these research results, it is feasible to achieve significant effect by 2050; new social contracts have to include these new considerations; important to organize alternative social institutions; unfortunately, it appears there will be even more polarization before

anyone will reach an agreement as to what the role of government will be; the powers to be will hold on and fight to maintain current systems until they completely break down.

6.3 General comments:

Groups that do the research end up with complex models of relationships, which they are unable to communicate, and other groups demand certain and simplistic solutions, which they communicate in emotional sound bites, and they reject the complex solutions based on research; necessary; for UBI to have any chance of being implemented, a new social contract between government and the governed will have to be forged that includes the possibility of actively unemployed and non-physically augmented geniuses; some countries may start providing incentive to attract these geniuses to their countries (brain-haven, like tax haven today); how volatile a social force would the augmented but unemployed 'geniuses' be, as it sounds like a recipe for political versus cultural revolution; how to evolve rather than have revolutions; if society/government does not work smoothly with future augmented geniuses their disappointment could lead to conflicts as they try to take or at least achieve what they think is their role in future business and government decisions, their integration must start when they are teenagers and will need a plan for their full lives.

Governments are ripe for change, more discourse on the shifted paradigm and deeper understanding of evolving world systems is needed with tangible solutions, taking into account that some international companies make more money than governments; the P2P foundation offers a new social contract:

<https://blog.p2pfoundation.net/author/michel>; governments and citizens revise their social contracts in each electoral cycle; AI will be the driver for change and governments will have to adapt; no doubt new social contracts will be created over time through universities, think tanks and other research bodies; I agree that a new social contract is needed but dislike the link to unemployed and augmented geniuses; if the extant system falls apart under its own weight there's a better chance for constructing a new social contract; pretty dangerous proposition; if government gives us everything we need it turns us from makers into full-time consumers; a new social contract is possible only among educated people; we need informed objective presentations of issues, ideas and alternatives to the ideological spins as part of the new social contract.

Suggested Action 7: Create a short-term mass awareness campaign involving celebrities with vast audiences to diffuse the message of coming new cultural paradigm.

7.1 How effective?

Very effective to quickly reach a wider audience; celebrities are listened to more than many prominent leaders; arts plant the seeds of ideas in peoples' minds and some of those people actually go on to create those new realities, technologies, paradigms, and cultural trends, so doing so on a massive scale to jump start that cultural change could be very effective if properly done with a broad range of celebrities from multiple fields collaborating in the public discussion on the sorts of options for cultural change; make sure this is culturally relevant in all cultures and not dominated by the US and EU, mass

audiences in India and Japan for example carry greater weight in the Asian region where the majority of the world's population lives; this will help, but it's only a small piece; in the current infobesity environment, this will be a splash in the ocean;

7.2 How feasible?

Very feasible with the right contacts, carefully crafted messages, using a wide range of celebrities, and not just entertainers, will ensure broader acceptance, and showing a discourse about the subject rather than just telling people what to think and instead engaging them in the process, will enhance its effectiveness and shorten the trajectory to significant impact; celebrities feel good about doing these things as it's good for their image; preparing for the future is often a missing piece in entertainment, we need more focus on being a better person, creating a better shared society for the future.

7.3 General Comments:

Why only short-term? From royalty to rock stars, people everywhere tend to imitate celebrities who practice and advocate new values and life-styles; let's use this as an element to usher in the coming new cultural paradigms sooner rather than later; I think it would be one of the best alternatives to spread the message; the ice bucket example led to more than 2.4 million tagged videos on Facebook:

https://en.wikipedia.org/wiki/Ice_Bucket_Challenge; another example of how a short-term mass awareness campaign can be effective: <http://www.udruga-gradova.hr/wordpress/wp-content/uploads/2016/07/5.-HKKKI.pdf>; there's a lot of positive action already being done, so bringing this to the fore could be rather effective.

Instead of mass campaign, better to diversify messages to fit specific audiences; people listen to icons they relate with; this needs a political start employing the planners, our current science and humanities professionals, as well as political leaders who can explain how this will be handled within society. people need to see clear examples of the possible actions and results, carefully broken down into small steps that we can all visualize; short-term campaigns will not have persistent influence on issues that are culture-driven; cultural change takes place in more subtle ways over time; celebrities are hardly the right persons for serious work; instead of mass awareness campaign, share information and invitation to think, to react, to invite people to be aware and interact, mass awareness campaign sounds too much like indoctrination.

Suggested Action 8: Conduct a systems analysis of all big players influencing culture, and then create and implement socio-art campaigns to help the public understand S&T in development.

8.1 How effective?

This could be very effective, if the relationships between science and technology and culture can be demonstrated in a self-explanatory way; good for awareness if it doesn't become too complex;

a good diagnosis is vital to subsequently act on the right "levers;" this could be very effective, but who initiates this, UNESCO, National Endowment for the Arts, some billionaire.

8.2 How feasible?

This might require some breakthroughs in human thinking; takes a lot of time and management; getting a systems analysis that provides insight into both the positive and negative influences of the big players could produce a balanced way forward to ensure greater impact sooner; depends on investments; maybe the companies would pay for it if they were chosen.

8.3 General comments:

Very important to conduct systems analysis of influences; both analysis of big players and changes are needed, as one influences the other; charts and graphs and media illustrations could be very effective in bringing awareness about these tightly interwoven systems that control so much of culture; for too long cultural agents have been speaking and having impact in their own circles, we need to break the bubble; show all sides; if big players include government, non-governmental organizations (unions, political parties, business groups), radio commentators and others with ideas, then it works, but cooperation among them is difficult; consider trustworthy advertising, meetings between scientists and opinion leaders, proper debates in Parliament, public meetings, instead of razz-matazz art campaign; big players change too rapidly; social engineering of a different order would be needed to affect change; we have mapped the creative cultural industries in Croatia to evaluate policy impact; clearly different for different areas, some relevant for China, some for US & Europe, seems a good idea, but difficult to implement globally; very mechanistic approach to culture; interesting that we refer to 'the state of the art' in science and also to artists' 'experiments' (as in, "experiment in blue"), people 'feel' art with their inarticulate senses, but there doesn't seem to be a similar sense of feel among non-scientists for what science is, how can the gap in aesthetics be bridged; a global and ubiquitous understanding of S&T requires a fundamental transformation of the architecture of the human enterprise; this analyses will take a very long time and is complicated since many new actors will be added constantly during the process.

Suggested Action 9: Establish associations, communities of practice, and/or arts/media alliances to create and help new social movements with themes such as self-employment as new norm, technology to augment human capacity rather than replace humans, self-actualization economy, invest in what replaces you, eco-empathy, and good news in media about positive actions.

9.1 How effective:

If these associations identified their improvement systems and then improved those systems, they would become more effective; most of our challenges today require ecosystem solutions; such associations, communities of practice and alliances will have to keep looking beyond their narrow self-interest, but doing this will greatly improve long-range work-technology culture; similar happenings on Meetup platforms; the development of alliances with robust players and from very diversified sectors are opportunities for the articulation between work and technology; most of these ideas will have come and gone by 2050.

9.2 How feasible?

We need good examples, there are so many elements in this one action and as a result there will be so many different self-interest groups fighting against this combination of positive changes in culture in the future, it won't happen without some support from government, and more policy than monetary support; would need to get buy in from media; this is key to the whole process.

9.3 General comments:

Yes! We are setting this up in Eindhoven, and we are open to collaborations across the world to compare results and best practices; anything like this will help society evolve, although I think a good deal of it will happen naturally over time; this level of detail and concern for potential audiences appears to have more possibility for success than the preceding initiative; seeing more of them portrayed and explained in media could be quite helpful to spur imaginations and confidence that these things are possible; this can be important when trying to integrate technology into society, to see groups who really care about these issues; technology to augment human capacity rather than replace humans, yes, also show incredible beauty of humanity in order to implement smart augmented reality; this would be a more modern way of initiating action, good, but stimulate critical and analytical minds with human empowerment otherwise it is manipulation rather than helping people to understand; expand the operation of the Corporation for National and Community Services; important, but only in a peripheral sense; a world-wide commitment and extensive resources to accomplish all this will be hard to get started under 20 years and then it will take another 20 or 30 years to implement these changes around the world.

Suggested Action 10: Invent ways to reduce social isolation of tele-workers and youth (teens are increasingly suffering from depression and increased self-harm and suicide due to excessive use of cell phones and social media).

10.1 How effective?

Use apps which give you all the solutions around your home to join a group of people who also need companionship; this can also be done using machine learning; ICTs influence "social isolation" but social values are what cause human behaviors; loneliness and isolation are a cultural problem that is exacerbated by tech use, but there may be ways to alleviate such feelings with help from technology and awareness; social isolation can be exacerbated by cyberbullying; de-humanization has been a meme with all new technologies.

10.2 How feasible?

Awards and attention to good practices to alleviate social isolation; promote responsible use, see South Korea's programs to counter cyber addicts; reduce it through cultural activities, possibly aided by technology; if done at the community level, it is possible, and broad scale dissemination and implementation along the lines of the US's First Lady's Cyberbullying initiative internationally.

10.3 General comments:

Essential to give every person a feeling of contribution and connection with others who are working on the same or even on completely different topics; needs trained motivators to help individuals through hard times; everyone needs someone to talk to about their own work and their progress or accomplishments, people will need broad recognition of what they are doing and what they have done, continually through their lifetime, not the work of a sycophant, but an honest and knowledgeable recognition of what they have found or added, or even have investigated and discarded, we all need encouragement; engage youth in more community based experiences and projects, after school creative programs, Yoga, physical activities, crafts and skills building, etc.; very important that they have personal engagement and socializing vs. isolation; social media is sometimes an answer to the isolation; grant aid in exchange for community work for young people for employment or reintegration; this is a civilization problem, maintaining human community in an increasingly technological age; this needs to start from a child's first day and be guided by thoughtful parenting, schooling, social education, media literacy training, and of course in-person activities; organizations like Birth2Work are doing great work in this arena; find a balance between the negative and positive effect of social media; directly connecting depression and increased self-harm with excessive use of cell phones seems short sighted and limited; needs integration with a wider range of initiatives; there are great social shifts and population migrations around the world, most of which are causing social isolation, loneliness, and depression, overuse of cell phones and social media is apparently making it worse, but the real solution is to enable people to feel connected and useful and productive; a good deal of this problem comes down to poor parenting; incorporate emotional intelligence; in social media there is a lack of immediate feedback/consequences for one's actions by persons known to the individual unlike feedback when in physical presence of others; a total paradigm shift may be required to fully address this.

Suggested Action 11: Expand the purpose of work to self-actualization and moving from “my job is my identity, value to society, and source of dignity” to my identity, value, and dignity is how I invent my life, how I give it purpose.

11.1 How effective?

It is vital to make sense of the job, but more vital to make sense of life, we are increasingly able to integrate work and human development; create a new community of practice named “I invent my life;” have those who see themselves as self-actualizing in their work disprove the naysayers; people who have this sense of self-worth and purpose are the most successful in finding what makes them happy, regardless of the financial rewards and, interestingly, they tend to be the kind of people other people want to hire or work with; that is the point of a self-actualizing economy; people need to be aware that they are their values and how they live out those values.

11.2 How feasible?

It will require continuous evolution in the education system and cultural evolution, but it is underway and might be possible by 2050; keep spreading the meme, purpose-driven has already become a bit of a buzzword and new millennial workers require a sense of purpose in their work; revise/establish institutions to be more human; hard, but feasible, and would be a critical lever to improve the future impact of technology on work; this should be a strong thread in education that helps people find themselves "inside" instead of seeking their purpose in external things.

11.3 General comments:

This captures the essence of the exercise, as we are able to see the role of the individual in the emerging culture-technology matrix; this is already happening more and more; self-actualization is indeed a good way to approach life during a time of great global transition; ultimately this is the general direction, but the "bottom billion" must have their needs met first before self-actualisation, that this is eminently doable over the next thirty-five years, but there are not yet enough signs that this will happen over the relevant time period; one still works to earn a living, but increasingly there are more choices of activities and roles to perform in society for our identity, interests, and personal strengths; this requires implementing in the family, early education, and in media representations, which will be more and more essential as automation, robotics, etc. evolve; this message is out there that educational systems should help children make progress in the direction of self-actualization and employers should recognize which potential employees fit the various cultural needs of a company; give tax incentives to social good enterprises; co-operatives, worker-owned businesses, and barter systems could go a long way towards developing this different approach, and income must rise to get people above the level of sheer survival to higher states of awareness and the support to and freedom to be creative; "I am me, I am not my job," these self-actualization direction should lead to happy people for a better and fairer world, this could be a start.

Suggested Action 12: Create Departments of Collaboration to help address the issues in the three Work/Tech 2050 Global Scenarios.

12.1 How effective:

We don't need more departments, we need everyone across industries and departments to learn and value collaboration, we need to teach it, model it, reward it, and publicize it as a societal expectation; have discussion of these scenarios on as many platforms as possible, not new departments.

12.2 How feasible:

Too many departments and agencies will be competing for budgets to collaborate, let alone spend new money on a collaboration department; there is interest in this topic, but not enough interest to have enough collaboration; there are government management instruments for this already, it is about putting them in motion.

12.3 General comments:

We have experience in these kinds of collaboration departments and results have been inspiring and effective; Departments of Collaboration have a long history of being unconnected and ignored; need facilitators not a new department; the issues will be addressed one way or another anyway, if a government department is needed at some point it will be created; this seems to lump everything into one solution, which alone won't solve the problem; presume these would be international and interlinked; global movements involving decision makers and financiers are highly effective, but also have risk of becoming a show only without results.

Suggested Action 13: Establish a government department or office of cultural impacts for Next Technologies (NT).

13.1 How effective?

Something like the US Office of Technology Assessment; seems like valid initiative; that should be a given. Sad it isn't...yes, to the extent that it implies a public commitment but that the structure does not become an end in itself; we have too much government already, and this seems to be adding more.

13.2 How feasible?

This would focus attention; this is not just something that should be done by the government, but rather by joint collaboration amongst government, private companies, academia, and NGOs; would require money invested into the future instead of into the military-industrial complex, fortunately, this is also a matter of national security, so there is a motivation for it; this is not a mission-critical initiative for agencies that are already budget-burdened; feasible in countries where governments have already spent a substantial amount thinking about the future.

13.3 General comments:

Better to re-activate and fund the Office of Technology Assessment; all governments must consider this, consult with civilians and experts, I will sign up for this; it should be part of the agenda of governments; this is only possible in real democracies; obvious to do; we have existing departments that can be redirected to make this happen; highly dependent on the individual country; it needs to be businesses or associations or private action groups/investments as governments are too political to be objective; Next Technologies (NT) should not be treated in isolation; most governments are more interested in how Next Technologies (NT) will make their countries more competitive, economically, in the future than they are in the cultural impacts, what is the proper technology-culture-economy formula; government offices could be made to act as facilitators at best—and just that, their role should be peripheral and not central; superfluous, since whatever department has responsibility for innovative technology will have to deal with impacts; some elements of this assessment are being done on the impacts of Facebook, texting, video games and internet usage on youth, would the purposes of this government department be regulation, policy development, monitoring, or what, each of those roles demands different structures, funding, and leadership.

Suggested Action 14: Establish the 'Integrity Idol' as an example of taking a popular culture template and putting it in the service of the public interest.

14.1 How effective?

Could be like an honorary position of UN goodwill ambassadors, but many would be needed in all age etc. categories; can't be only one, needs to be a diverse enough group to be an inclusive narrative; this is similar to a previously-listed initiative, but could have value and buy-in by celebrities.

14.2 How feasible?

Very feasible if they are very active and enough attention given to these idols in media; references to such people would help the process of understanding the potential future work-tech dynamics; the "Integrity Idol" can certainly be established, but having a significant influence by 2050 is questionable.

14.3 General comments:

Each culture has imaginary idols; this has been done since humans started telling myths such as Norse Valkyrie Brunhilde daughter of Odin or more contemporary examples like Smokey the Bear and Rosie the Riveter, who constantly reinforce positive ideals, however, this can only be used as a reinforcing tool and is not likely to be strong enough to stand on its own; recognition of people with integrity is very important; some new, more positive "idols" are needed for popular culture; advertising often uses an 'idol' to represent the brand, whether it is a real celebrity or a fictitious one, but idols often fail and their integrity score is likely to fluctuate (Steve Jobs, Donald Trump), while impact can be large, it can also go horribly wrong; producers of The Voice, American Idol, etc. could include social impact in their conversations, requirements, etc. or create a variation of this type of TV show with content from this study, it could happen quickly, GOOD magazine is doing a good job at getting out positive information.

Suggested Action 15: Support joint cultural activities with other countries that re-enforce new values to help the transition to the next rapidly change techno/economic realities.

15.1 How effective?

This can only enrich the process of processing the rapidly changing realities in one's own country; intercultural learning is always productive; would help to share experiences and to see how different cultures adapt technologies to fit their own culture; the more we can do to foster planetary thinking, the better; an international coalition might have chance of success; hybridization is a key to success.

15.2 How feasible?

There are numerous activities already doing this to varying degrees, e.g., the international movies, publishing, and other media industries with festivals and competitions encourage such interchanges, and international agencies like the ILO, the UN, and international research entities, in theory at least, are supposed to be doing this

as well; combining this with Q#9 & Q#11 will further enhance its feasibility and impact; embassies and houses of commerce could take a lead in these activities; make it a trade fair, as reinforcing values will come more from need to change rather than desire to change.

15.3 General comments:

Love this idea, anytime we can come together on a global level is a powerful opportunity for getting attention to this type of convergence, look at sports—imagine the Olympics of Human Potential; a long-term approach with ongoing series of joint cultural events will be needed to engender real, broad scale change in values that will help the general public transition/adjust to rapidly changing techno-economic realities; this one could easily be combined with other actions in this list; there's more of this going on all the time already, perhaps more awareness of it would raise the effectiveness and ease of implementation; multi-cultural initiatives can help share and shape future of tech and work; the power of a creative economy depends on placing products and services to a large number of foreign markets.

Suggested Action 16: Repurpose libraries, old post offices, movie theaters, national parks, museums as well as “maker spaces” as “creative placemaking,” hubs for integrating the arts and community building – a nexus for creative contribution, life-long learning, cultural exchange, and Next Tech/digital connection places.

16.1 How effective?

Familiar places with new public/interactive uses is always a very attractive idea; many community libraries and theatres are already repurposing or at least adjusting to the changing times with their offerings, including Next Tech/digital connection places, but those efforts can be taken much further as far as "creative placemaking hubs" and community building nexus, this could be part of the solution to offset the isolation of youth and teleworkers as well as enhance lifelong learning; seems like a very effective way to avoid premature obsolescence of existing facilities and efficient introduction of new environments; St. Petersburg in Russia is opening creative and media clusters for citizens and tourists.

16.2 How feasible?

Especially if future thinking leaders get involved in this repurposing/refurbishing process, the impacts could be very significant; seems low-cost, high-return; turn these elements into centers of acquisition and development of personal and professional competences; many examples already exist, which should be "marketed" in media.

16.3 General comments:

This is inevitable; we have seen some of this already, such as libraries that have maker spaces or host demonstrations and museums that implement new technology into their existing collections, why isn't there some kind of national movement to do so; it needs to be promoted so that more communities become more active in doing the same on an

ongoing basis, use different business models for financing facilities such that they can remain relevant to constantly changing technology and media and social trends; include outdated schools and facilities where demographics have shifted; these spaces tend to cater to those with wealth or leisure, so they have to be done well and en masse, and stay very dynamic, in order to continue to thrive with the community; making the general public and policy makers more aware of this will go a long way; truly engage citizens, not conferences or artistic manifestations, make this type of content relevant for populations, encouraging their participation, changing mindsets, and making people take responsibility for the society they are part of; accessibility to such facilities would allow the arts and sciences to strengthen the public's access; as long as the influence is to strengthen the artistic minds of the public, the benefits will be great and far-ranging, previous example in the US was the Works Progress Administration that allowed people to not only work but to express their artistic selves in a wide range of arts in public spaces.

Suggested Action 17: Make this study (initial research, global scenarios, and actions) available to cultural and art leaders around the world by conferences and other means.

17.1 How effective?

Dissemination of the project is needed; not just conferences but stimulate action; depends on how many Millennium Project Nodes and others take it on; conference presentations should be opened to wider audience at the same time or as pre- or post - conference sessions; this would help and should definitely be published, but recommendations should be more specific.

17.2 How feasible?

Some momentum seems to be gathering from more political and cultural leaders around the world asking to learn more about this study; a PR campaign may be needed to further build upon and expand that momentum to the point that significant impact can result from it by 2050; makes good content for presentations in conferences; I expect some of the participants in this study already plan to do it.

17.3 General comments:

This coming economic transition needs many new concepts, definitions, policies, education curricula, intellectual property rights, and measures—a conference could explore all of these; this is very important to make it a continuous process of conferences, meetings, etc. to create a coherent global framework; broadly enough disseminated in the coming 2-3 years and in a concerted manner such as via every type of conference imaginable, this study could become an annual best seller, with far more contributors to it that it currently has, but only focusing on cultural and art leaders won't achieve that [editor's note: the actions relative to culture is 1/5 of the full report, the other sections are education, government, business/labor, and S&T], this activity needs to be much broader and reach socio-political and business and religious leaders as well, the point isn't just the study getting into more hands, but the conversations that will result from people reading and trying to apply something different in their planning and

everyday lives; try the news show leaders instead, conferences are a start, what works better is to get this in schools and continuing education systems; how to make these results available to all people and have actions as an output rather than just information input; there will be a report out at The Millennium Project Planning Committee Meeting this October in Bolivia, is that right; in addition to conferences, use meet-ups, The Millennium Project website, other outreach programs, and encourage all Members of the Nodes to participate in getting out the word on their own websites and social media; generate synergies and communities; remember that the larger the use of art, the greater the possibility of it becoming propaganda, just because we're trying to do good does not mean everyone wants good done to them.

18 Additional Suggested Actions from the Panel: What other long-range culture/arts/media strategies would better improve work/technology dynamics by 2050? [Some suggestions were not included that were covered in the four other Real-Time Delphi studies that will go into the final report]

- Use big digital screens in urban streetscape, presenting a claim or proposition concerning work/technology 2050 and passers-by could add their comments and solutions.
- Use universal basic income to encourage volunteering and participating in social and cultural projects.
- Work with National Endowments and other funding bodies to bookmark certain percentage of funding toward future-oriented projects.
- Study future use and impacts cultural drivers for change.
- All of these activities are really needed, but keep in mind when creating strategies for the cultural transitions, that culture is not just art and media.
- Involve religious organizations and leaders.
- Make special efforts to involve disconnected communities into the discourse and trainings available for future of technology and work creation.
- Offer writing prizes that use the content in the scenarios.
- Create a "Future Dialogue Forum."
- Study more about how to create opportunities for meaningful lives.
- Build capacities of "cultural managers" to help lead cultural initiatives for potential futures

- Discussion should be initiated on global level, involving people that express themselves through images, spoken word, not only the ones who express themselves in written papers, we need different mindsets to be able to reflect and to be heard.
- Create more interaction, more mutual awareness programs, more engagement with work/technology stakeholders and decision-makers, policy makers, educators, and the general public.
- As of right now we have the communications tech to easily implement the outreach. But given the fragility of the communications systems (satellites vulnerable to EMTs, sabotage, hacking, etc.) it'd be good to have solid physical disbursement systems in place as well: actual print media, co-op and town hall meetings, etc.
- Conduct a thorough evaluation of the roles and impact that the arts can perform in external sectors other than the cultural and the artistic. The narrative of the value of creativity and the arts in the tech and business world is becoming more and more prominent, but little evidence is given of its value beyond the critical and the aesthetics outside the cultural and the artistic one.
- Promote fields such as archaeology and anthropology which trace back to the value and values of humanity, inspiring people to make something bigger than themselves. The exposure of man to these sciences can help lay the groundwork for many of the ideas expressed in these questions. After all, who has not been inspired by the Sphinx and Pyramids, or even the scribblings on the wall by a cave man? Understanding the value of the past will lead us to appreciate the value of our future.
- Keep arts education in the school systems from K-12, teach media and media tech literacy and use as medium for projects.

One participant suggested a series of weblinks and websites:

KEA European Affairs is an international policy design research center specialized in culture and creative industry as well as sport <http://www.keanet.eu/> most recent publication: <http://www.keanet.eu/publications/>; KEA 2018, Creative Europe: Towards the Next Programme Generation: http://www.keanet.eu/wp-content/uploads/IPOL_STU2018617479_EN.pdf; ongoing projects: <http://www.keanet.eu/projects/>.

Creative Europe Annual Work Programmes & EACEA:

https://ec.europa.eu/programmes/creative-europe/sites/creative-europe/files/c-2017-6002_en.pdf and EACEA: https://eacea.ec.europa.eu/creative-europe_en Christian Ehler, Luigi Morgano, European Parliament Report on a coherent EU policy for CCIs, 2016.

Websites and databases:

1. EACEA database
2. MAVISE database
3. <https://www.abconcerts.be/en/>
4. <http://asociatiametropolis.ro/>
5. <https://www.creativehubs.eu/>
6. www.creativetracks.org
7. <http://circulardesigneurope.eu/>
8. <http://connectingaudiences.eu/>
9. <http://www.cultureforcitiesandregions.eu/>
10. <https://www.cultureinexternalrelations.eu/>
11. <https://www.culturepartnership.eu/en>
12. <https://etendering.ted.europa.eu/general/page.html?name=home>
13. <https://www.eunicglobal.eu/>
14. <http://www.eif.org/index.htm>
15. <https://ec.europa.eu/digital-single-market/en>
16. <http://www.europarl.europa.eu/portal/en>
17. <http://liveeurope.eu/>
18. <https://www.live-skills.eu/about>
19. <https://luxprize.eu/>
20. <https://www.medculture.eu/>
21. <http://www.project-musa.eu/fr/>
22. <http://www.torinofilmlab.it/>
23. <https://weare-europe.eu/en/home>

Some parting comments from participants: Thank You So Much; it's very useful for biz, life and our organisation. Thank you so much. Thanks for your work.

Science and Technology

Distillation of participants' explanations and comments per each question:

Suggested Action 1: The S&T community should work with their government to create an office or agency for technology assessment to both anticipate potential negative outcomes to avoid repeating past disasters and to anticipate positive outcomes to ensure benefits are achieved and available.

1.1 How effective?

Huge first step, since politicians and their staff are largely uninformed about specifics about the implications of S&T and have no balanced source of information; will have a great impact in my country specially if the S&T community is involved because

government S&T actions are inadequate; if adequately staffed it will have a significant impact; the acceleration of tech change increases the need for this every day, and its public outreach should be stressed; will contribute to having a better scenario in 2050; strategic alliances for open collaborative work are a powerful way to go forward; there is a need for a global, leaderless organization to consolidate the activities of cooperating countries around the world; government's decisions must be based on knowledge, open to dialogue, and an office of this type is very important; effectiveness depends on ability to enforce policy, in a free capitalist economy it is doubtful that industries can be regulated by virtue of "possible negative outcomes" except in the most extreme cases (i.e. climate change); while of utmost importance, suggesting that one government agency can cover the extremely broad range of technologies is asking a bit much, besides, we already have the Food and Drug Agency and other monitoring and prior approval agencies, that are challenged enough by the influence of self-interest groups to do the job they were mandated to do, perhaps narrowing down what critical tech, like AI for example, would help make this action more realistic; the idea of Technology Assessment Agencies affecting the rate and direction of technological change has yet to be demonstrated (and it has been tried for more than 30 years); bureaucracy will ruin technology assessment.

1.2 How feasible?

Easier in some countries than others, but lower income countries could draw on the output of richer countries; if each individual government has to be sold on the concept, it will take too long, instead have an international organization, like The Millennium Project, volunteer as many Nodes as possible to lead the effort in each country, that decision will provide each country with a knowledgeable cadre; this would require action outside of government to make synergy with the S&T community; unless the role(s) of this agency are narrowed down, there is little chance of it having any significant impact, but if it is more focused on AI, for example, then it could have significant impact by 2050; countries where ideological messages are more important than scientific facts or opinions will resist this; the reluctance of ignorant policy-makers to listen to anyone except some lobbyists makes this very difficult; in my country the government keeps changing, so it's feasible only if the government has long-term vision to implement and make it last into future administrations; in Mexico there is already an office with the elements that will allow it to solidify and transform itself into an agency with the required characteristics; the Argentinian's crisis might help Latin American governments to understand the urgency and need for analysis of possible future national economies, which are currently based on natural resources instead of knowledge.

1.3 General comments?

Of course, the S&T community should work with their government to create an office or agency for technology assessment; not only the S&T community but also foresight experts; it must have some sort of "teeth," politicians must feel that their future is dependent on the right (and evidence-based) future-oriented decisions; it can be very effective, and should be very feasible to implement since such agencies are already in place in several countries; necessary to allow for independent views so they are not influenced by what others have already said; the assessment of negative outcomes of

technologies is in the hands of very few people who may not consider outcomes outside of their field of expertise, so a diversified group of thinkers should weigh in to give a more balanced perspective; many politicians are under pressure from various social groups and religious organizations to reject or modulate science in order to fit their beliefs about how the universe works; commissions of parliamentarians that can review the legislation in light of future technologies and make a coordination among agencies has been effective in my country; many S&T companies are global which will complicate the matter of working together with "their government;" how could such government agencies anticipate things and take action fast enough; the S&T community needs less government interference; industrial policy has had a checkered past in picking technology winners and losers, better to assess and adjust the economic incentives in line with the societal goals; there are a plethora of government regulatory agencies dedicated to protecting the population from inappropriate technologies (FDA, AEC, USDA, etc.), and the range of technologies to assess is so broad that no one agency could do it well, narrowing the focus of this new agency to something like AI in all its forms could help to make it more effective; a goal will have to be defined for this organization similar to "how do we put a man on the moon and return him safely by the end of the decade?", or similar to the MP's 15 Global Challenges; one problem with the old OTA in the US was that too often it assessed tech that was already in the market, too late to have much impact, ways to prevent politics and lobbying distorting reports has to be created; being too late was not the problem with OTA, it was politics that killed it, we need it back.

Suggested Action 2: Directors of national science labs and other leaders in the S&T community should devote more effort to making current science and future technology understandable to general public.

2.1 How effective:

This action is vital, as too many in societies resist what they don't understand only because they don't understand it; much communication is needed, little is done; such directors should make alliance with traditional media; public also has to be motivated to engage the labs in discussion; an informed citizenry might also put the right pressure on politicians and eventually help with the dialogue with the S&T community; important to avoid the danger of a divided society that does not understand science and the other that values science; a society that appreciates science will certainly promote a long-term vision and take timely measures in relation to technological development; the accelerating technology will make it easier to present data specific to the cognitive learning styles of individuals.

2.2 How feasible?

Over ten years ago, The Millennium Project did a study on future management of S&T, during the study all directors of national labs interviewed said they had the responsibility to inform the public of their work and would take communication training to improve their impact; science communication skills are usually missing, an effort is required to train both directors and grass root scientists; it might need some efforts from the S&T

community to better visualize the data including online interactive models the public can easily use; it would be ideal to create a position specifically for outreach, a "lab spokesperson", however in general national science labs are tight on money and are unlikely to create a position for this job; just takes a directive from the relevant authority to say do it, and add some small funds in their budget to make it happen; relatively easy, since most research centers do have a PR department; most labs already post news releases and even hold public forums regarding their accomplishments, but making science understandable to the public takes a budget and time away from conducting research that is unlikely to get funded; Discovery channel and related TV shows are good, but more is needed, in schools and the mainstream media of all sorts; web videos (like YouTube) should make this task much easier.

2.3 General comments:

Examples of graduate degrees in science writing: <http://sciwrite.mit.edu> and <http://advanced.jhu.edu/academics/graduate-degree-programs/science-writing/>, us AAAS's Mass Media Science and Engineering Fellowship program (<https://www.aaas.org/news/mass-media-fellows-prepare-summer-science-journalism>), Science communicators entice their readers with carefully selected wording, key interviews, visually stunning images, and a compelling angle, see Best American Science and Nature Writing <https://www.publishersweekly.com/978-1-328-71551-7> and Science and Entertainment Exchange, a program of the National Academy of Sciences <http://scienceandentertainmentexchange.org/about/about-the-program/>, the Exchange worked on a number of popular films and television shows with the power to reach the common person and shape their ideas about what science is about and what scientists do. For example, the Big Bang Theory (physics), House (medicine), and Bones (forensic anthropology). "Broadcast in more than 25 countries, The Big Bang Theory has achieved worldwide commercial success. As Steven Paul Leiva opined in the Los Angeles Times in 2009, "The Big Bang Theory" is the finest and best fictional portrayal of scientists in any current media—and a series that is carving out a place for itself in the annals of television comedy." (Physics Today, <https://physicstoday.scitation.org/doi/pdf/10.1063/PT.3.3427>); Help people envision possible outcomes when a technological innovation becomes mainstream, show, don't tell, a TV series like "Black Mirror" reaches a wider audience than science channels do; explaining how the technology works is less important than explaining how it will affect people's lives.

Granted, many top scientists don't want to deal with the public, but you don't need all top scientists, just a few, and those who don't want to deal with the public should support those who do, in part, Carl Sagan was a successful communicator because fellow scientists did not try to put him down, but supported his public leadership; Better S&T communications is definitely needed to counter nationalist and silo thinking, especially in the age of "post truth" and "fake news," people must be educated to be able to distinguish between (real) facts and conspiracy theories, distorted or biased opinions, etc.; this was one of the priorities of the current EU S&T framework program (Horizon2020); NASA and the ESA have great educational outreach efforts, but how many actually partake? The task is particularly challenging in developing countries

where large scale illiteracy still remains a problem; necessary to have a strategic agreement between the S&T agency, the universities and the social media; this question relates to the survey on education, on how to teach people to engage in continuous learning and lifelong education; as Next Technologies (NT) proliferate the knowledge gap between the educated and uneducated will have significant negative impact on the uneducated cohort in each country; people get scared from what they do not understand and can get paranoid; how to get more of the general public to read Science News, Popular Science, Popular Mechanics, and the Christian Science Monitor, as well on line sources?

Suggested action 3: AI leaders should work with government and international organizations to create international standards and governance systems for the transition from artificial narrow intelligence to artificial general intelligence.

3.1 How effective?

Without them we face the disasters that Gates, Hawkins, and Musk have warned about, imagine the world today if we did not have the standards and a governance system (IAEA) for nuclear energy; this is definitely needed, especially as it relates in any way to the application of military weaponry, otherwise there will be serious backlash against the development of artificial general intelligence; international agreement on AI systems standards and application will be very challenging, though it is important that attempts are made to keep up with developments in the AI field globally; I do think that the deployment of AI systems requires different regulatory frameworks, and that this is a very important conversation; given the dangerous military applications of AI, it is imperative to have a governance structure with the same abilities applied to nuclear weapons, including sanctions; international guidelines are essential, even though not everyone will adhere properly, the effort still must be made; in Latin America we must sit down to work more on this issue, we have been simple users of technology, it is an urgent issue to address.

3.2 How feasible?

The framework to do it is already out there, so it should not be too difficult, but probably it will take some time; it will happen; we are already too far behind to be effective on this; complicated, difficult, but necessary; requires a new class of educated political leaders dedicated to the common good; it is feasible like creating the International Atomic Energy Agency, but it will take some time; very challenging to get international agreement on AI standards since so few people in governments have sufficient understanding of it to be able to approve what would be effective standards for systems transitions; it is impossible since no one really knows what the real AGI will look like, feel like, and act like, hence there is a huge risk that this will lead to increased government spending and that is all.

3.3 General comments:

Industry is far ahead already and will set standards on its own if public organizations do not catch up quickly; it is so important that leaders should work with government and international organizations to create international standards and governance systems

for the transition from artificial narrow intelligence to artificial general intelligence; tech creators often don't want regulations, but this is different, the potential for acceleration means that if we wait too long, it will be too late—if AGI is created, we have no idea how fast artificial super intelligence (ASI) could emerge; this is very important and it is best left to practitioners and leaders of AI and not to governments, which should limit their role to being facilitators for it; standardization in S&T cuts two ways: makes more hardware able to integrate with others, but can hold back advances; this would be effective but how could we ever agree on something this complex like AI; since the conflict of interest among countries is significant, bilateral and/or regional agreements may be necessary before a global general agreement is possible; while agreement on standards may result in accelerating the implementation of the technology, there is a danger that AI be used as a major tool for government's to maintain control over its citizens; recommended reading:

<https://www.theatlantic.com/magazine/archive/2018/10/yuval-noah-harari-technology-tyranny/568330/>; a complicated issue for Latin America, since we are only users and consumers; AI should not be hampered by regulations and standards at its beginning stages; this would require addressing a persistent paradox—AI leaders are ignorant about the full spectrum of political and social effects, while politicians are ignorant about AI impacts; this suggestion is based on a nation-state paradigm which does not match the real world of global corporations, are Google and IBM really American; I don't believe international governance systems are currently open to this question; we need a new class of informed and visionary politicians.

We had a similar discussion about nanotechnology in the early '90s and very little happened, as 'nano' diffused into materials, energy, and medical research and basic safety standards took over, perhaps the same will happen with AI, perhaps the role of an international standards body is to inform local or industry-specific standards bodies to adjust their standards to deal with AI as it appears; the issue is the integrated control overall system for the Internet of Things (IOT), which is far more inevitable than human-level AI, standards are needed FIRST for theorem-based security of operating systems, communications, and chips (in that order, because OS's are easier), and overselling of fake AI is also a major problem, replacing humans at times with systems which do not actually work as well; maybe when AI or AGI will get to replace policy-makers, it will develop some codes of conduct—for better or worse.

Suggested Action 4: Create alternative roadmaps to the development of artificial general intelligence and identify likely impacts of artificial narrow intelligence vs. artificial general intelligence by years, and make the results widely known.

4.1 How effective?

This is an important undertaking capable of fighting the ongoing hype about AI and the useful reframing of AI and AGI; the current international conversation on AI continually confuses narrow, general, and super AI making policy and public discussions very misleading; would help expand understanding of AGI, how it works, and how it is self-evolving and the sorts of controls needed to prevent humans from being subjugated to it rather than enhanced by it; alternative roadmaps would be necessary to deal with

exponential contexts of development; seems an impossible task to identify impacts for a technology so alien to anything we have experienced so far, nevertheless it is a useful exercise.

4.2 How feasible?

Some exist, but not well-packaged and communicated for public consumption; there will be lots of these at the international, government, and individual corporate planning levels; it is vital but complex in that it will have to combine different interests (sometimes opposed); we definitely need to appropriately identify who will/should develop these scenarios if it is to have the sort of positive impact wanted, because if left to the developers of it, they will not anticipate well enough some of the consequences; who will have the knowledge, motivation, and incentives to do this; could make a difference if it is widely distributed.

4.3 General comments:

This is the best approach at the current stage of AI; it is so important to create alternative road-maps to the development of artificial general intelligence; assume governments are investigating the consequences of being behind on these technologies, especially in military applications; organizations like Partnership on AI, Future of Life Institute should take this on along with Google and IBM. The Human Genome Project has little backlash, probably because public communications was built into the budget from the beginning. it might be most effective if each industry develops its own AI roadmap, few industry roadmaps are as effective as the one for the Semiconductor Industry Association which has been predicting outcomes, because nearly everyone in the supply chain takes part in it and it has driven research and capital investments; who will be burdened with this non-productive task (in relation to individual efforts by S&T entities); the sector is focused on gaining the greatest profits, which alternative roadmaps may put at risk; can be conducted as global study, but global co-operation will be difficult at government levels; the MP can start it right now; needs to be done by independent persons/entities to avoid self-perpetuating biases of implementers being built into them, then media campaigns through a wide variety of channels and sponsors including government, academia, private foundations, and the private sector as well; most seem to begin with the applications, products and services one prefers to see, rather than with the probable science and technology breakthroughs that will be necessary; without regulation and enforcement, the focus will remain on short-term gains with long-term dangers; it is vital that governments, especially in the US and China, get more involved in steering this journey away from quick wins and financial gratifications; it might be too future forward and abstract for many of us to feel the urge to act now on it; nevertheless, alternative roadmap may be valuable, but to give a timeframe is pure guessing.

Suggested Action 5: S&T and legal communities should collaborate nationally and internationally to establish legal frameworks and treaties that anticipate future liability requirements that can deter technological hazards and encourage technology benefiting humanity.

5.1 How effective?

This is really complex, so the sooner we get working on it the better; this is much needed and could even pave the way for better competition and hopefully produce useful results and technology; without a doubt, I am totally in favor of this implementation as collaboration between the academic and scientific community is the only thing that can bring improvements to society; future legal arguments will need new rulings to establish who or what is a legal entity and what are the legal responsibilities of such entities in a world that includes AI; this is a noble goal, however it may be difficult in the absence of real-world issues since often it is pain that motivates policies, when issues arise and lawsuits result, policies will follow; yes, it is a noble goal, and one that specialized government regulatory agencies such as the FDA, USDA, EPA and others should address, but with existing technologies let alone the new ones with AI enhancements make this difficult; reaching a consensus is not easy sometimes but could be managed as recommended by William Ury (founded the International Negotiation Network).

5.2 How feasible?

Complicated yet necessary; legal conferences and international meetings can include panels of legal experts to debate the specifics of AI in legal terms and definitions; self-interest groups have shown to be effective at infiltrating regulatory agencies such as the FDA and corrupting their determinations at the expense of the public, so, while this is definitely needed, for it to have the desired effect, will require cleaning up existing regulatory structures and preventing their political dismantling by feckless individuals in power; S&T communities may not be that interested in such arrangements; the chance of reaching a consensus looks remote due to cultural differences related to risk-taking. for example, the European emphasis on proof of avoidance of any harm can inhibit innovation while the U.S. utilitarian risk/reward approach can lead to unforeseen disastrous consequences for those who had no say in the decisions; I expect that legislation will follow—not precede—harmful results.

5.3 General comments:

Pay attention to the warnings of Steven Hawkins and others, it is urgent that the scientific community get an agreement and push the governments, academy, companies, and international organizations to establish a general framework; rather than wait for legal complexities to occur, it seems better to get ahead of the curve and demand that legal professionals worldwide begin to debate it and for courts to issue preliminary opinions; this has worked with nuclear, chemical, genetic technologies; legal frameworks that define future liability are useful to expedite S&T development, the exploration and understanding of technological hazards is already a requirement of engineering best practices; creating international legal frameworks—while necessary—

takes time to build consensus across countries, and then more time for implementation, yet, it is an essential exercise; alternatively it is easier to insist on creating national legal frameworks first, and then move gradually to create an international consensus; legal frameworks and treaties can renew a focus on developing technologies that benefit humanity, numerous scholars have provided both critique of unsustainable systems, and ideas for innovation; these critical discussions need to move out of the academy and into the S&T development community; who decides when something is a liability or a hazard and when something is beneficial; finding common ground could be extremely difficult, especially when it comes to military applications (secrecy and one-upmanship); when the rule of law is barely functional in as many places in the world as it is at present, the implementation of any international agreements will be inconsistent; must be interpellation among all relevant actors; not only S&T and legal communities, but also social and human science (very important foresight and bioethics experts) and civil organizations; governments are slow to react to change—communities need to petition them to keep up with tech change.

Suggested Action 6: Establish International S&T Organization as an online collective intelligence system (not as a new bureaucracy) that shares on a global basis forecasts of technology, their potential impacts, and a range of views updated similarly to Wikipedia—but with more peer review systems built in. The system should show contradictions, differences put next to each other with links to data and research, and act as an early warning alert system.

6.1 How effective?

Peer-reviewed, self-correcting well-monitored information sources like Wikipedia are a good idea; why compete with Wikipedia, it can be used to manipulate people, with the proper peer review systems this could be extremely valuable, accurate data is a good thing; this should be the central focus or baseline information utility from which the world learns from and contributes to, this could make other systems, laws, regularization, etc. more effective and intelligent; given the problems with online collective experience, particularly around fraud, misinformation, disinformation, cybercrime, corruption, and worse—this seems too vulnerable, too idealistic and too voluntary, access and implementation would be very difficult to manage; this can be implemented under the umbrella of UN; getting into agreements when things are not yet stable and inequalities are common is not an easy job; we already used such Livejournal in Russia although DDOSed and spammed for political reasons, Occam's razor should be used instead of creating new entities.

6.2 How feasible?

If this is an extra-governmental organization, that includes inputs from government, and with effective media campaigns to raise public and government and academia awareness of its existence, then it could have significant impact by 2050; it's a kind of movement that requires a good critical and well-prepared mass to implement; it must be possible; it is not difficult, just a matter of willingness and some dedicated organization that would continually monitor it and make sure updates are happening on a continual basis; it comes down to distribution and ease of use; although relatively easy to set up,

they are more difficult to sustain, and eventually they become abused by self-interested parties canceling each other out inside the wiki and overwhelmed by unreliable and fake news spread more widely outside the wiki; the lack of present day political action to seriously mitigate climate change shows that though the body politic has been given 'early warning' alerts of extremely dangerous and damaging conditions, leadership has opted to value the profit margins of their funders over safety, this is a precedent that cannot be ignored.

6.3 General comments:

In this age of real-time communication across the world, it is inevitable that there will be a free flow of exchange and information between international S&T organizations as an online collective, by 2050, one would imagine many more technological breakthroughs happening that would radically transform the nature of connectivity across regions and nations; of course this is essential, but what kind of organization, how to get it right, needs a rich network of two-way, n-way information flows that any real intelligent system would have; The Millennium Project and the other similar think tanks at global and regional or national levels, have to create a joint system of AI, working together and meeting at least once a year, similar to what the WEF does in Davos, in a Summit of World Collective Intelligence System; agree that the system should show contradictions, differences put next to each other with links to data and research, and act as an early warning alert system; the International S&T Organization has to be an international self-regulator to work; depends on finding someone with enough gravitas to get this going; this may have to be an extra-governmental entity, if it is to not get bogged down in petty politics and bureaucracy such as evidenced in the UN and other international systems; it is definitely needed and will need effective peer review systems built in without fossilizing the results in the process; this is quite feasible but seems mostly focused on sharing information, not necessarily on doing something with the information, how do we apply the info; we joke that a lie can run around the world twice before the truth has time to put its shoes on; if citizens are not trained to question what they read and trained to investigate questionable information, establishing yet another source of information, no matter how reliable, will be ineffective.

Suggested Action 7: Forecast how synthetic biology will or will not create more jobs than other next technologies (NTs) replace.

7.1 How effective?

As a generalization, the world is ignorant about synthetic biology and its potential future; synthetic biology is opening a wide variety of possibilities particularly when following biomimicry, learning with nature; there are so many wild assertions as to how synthetic biology will create jobs in the future, without any real analysis, that any legitimate and detailed forecast would be better than what we are doing now; it can only be completed if accurate forecasts of all NT job replacements are available; two different exercises for this study: how many jobs does synthetic biology create and how many are destroyed in other technologies, the "long-term" discussion will be in terms of "hours of employment" and not "number of jobs;" a great tool for terrorists, so it could create lots

of jobs tracking them down; this should be both on jobs and ethics of synthetic biology to be of real long-term relevance for society; it might create more work after synthetic biology causes some eco systems disasters.

7.2 How feasible:

As we move appropriately in this direction there would be many possibilities that may benefit global well-being; doesn't the ILO provide any of this analysis of trends in jobs globally already, maybe what is needed is a better futures department in that organization with some help from such groups as The Millennium Project network; past efforts to do such a thing with, for instance, robots, have provided a number of existing robots for jobs, but unreliable forecasts; it will depend on "geographic" and "time" terms: lag in times between the jobs that are destroyed and those that are created and in what territories are they created and destroyed.

7.3 General comments:

A challenge, but a good one; it is not clear how synthetic biology will affect jobs, that's the reason why the MP research projects are so important, because they create possible scenarios; synthetic biology is in its infancy and it is too early to make any reliable forecast about future employment creation; why focus only on synthetic biology?

Suggested Actin 8: Forecast synergies among the full range of next technologies (NTs), and their potential impacts (e.g., artificial intelligence, robotics, synthetic biology, nanotechnology, quantum computing, 3D/4D printing and bio-printing, IoT (Internet of Things), drones (and other autonomous vehicles), VR (virtual reality) and AR (augmented reality), cloud analytics, conscious-technology, semantic web, holographic communications, blockchain, and tele-presence).

8.1 How effective?

It could be very effective for supporting the work of the education and learning actions, as well as cultural transformation actions because realizing the technological links between sectors and making that known could help more people relate with and prepare for those changes; it is certainly very important for the business world to know where to invest, hence very effective for NT development but not clear how effective for improving work/tech relations; life works with synergies and this extends S&T; such road maps need to show the complex relationships to be effective; the only way this synergy will arise is by setting a master plan or one goal to restore the planet to the sustainable level so humans can survive, otherwise we will have to emerge into the matrix by destroying the other species while cooling the planet; it is a good exercise, but would likely not be a substantial industry driver; hybridization of technologies is what is really going to give potential to each technology.

8.2 How feasible?

Easy, just fund several research institutes to do the study and compare the results; a few industry-level technology road maps do occasionally work well in guiding investments in many interconnected technologies at once; some in the private sector are doing this as they develop their new products, but sharing proprietary information is

not likely; to forecast the impact of hypothetical advances in any one technology is difficult but a reliable forecast of real world synergies of all of them seems beyond our current capability.

8.3 General comments:

Another good challenge—extremely necessary; will help identify the unintended consequences of the integration and interaction of NT technologies to prevent bad scenarios from developing; this would have to be done on an international level to achieve the full potential impacts from it on the future of work and technology, it could make a difference if this analysis is accessible very broadly across the world, in both government, private, academia, media and other sectors; the wide spectrum of NTs promises a quantum leap in generating synergies the actual range of which we may not be able to grasp at this stage, something that one may easily be able to predict is that these would vastly improve the work-technology prospects for 2050, this is still uncharted territory that would be very effective and feasible; in general, the more complex the supply chain, the longer it will take for all the complex relationships to solve themselves, but where something like the Semiconductor Industry Association roadmap has worked, competitors for solutions to each link in the chain in the long term (6 to 12 years or longer) can anticipate when and where an investment might pay off in the 3 to 5-year time frame, get funding from venture capitalists or others, and move the industry forward in a reliable way, as for the long-term 'human side' of the equation (beyond 12 years), perhaps it is best to leave this to science fiction writers, who can explore scenarios in dialog and relationships between people in a way that technology forecasts usually cannot.

Suggested Challenge 9: Scientific associations (e.g., International Science Council, national academies of science, etc.) should develop methods and procedures to carry out their responsibilities to establish and communicate scientific facts as AI could dramatically accelerate the impact of disinformation.

9.1 How effective?

Certainly an important part of the equation; would help avoid disinformation; since they are the source/focus for scientific knowledge, who else could be more effective, naturally depends on how seriously they take this responsibility, their relation with or use of social media would be very important; very important, the regulation that creates these institutions should impose this obligation urgently; it would be essential in order to foster more inclusive and collaborative work worldwide through the web; this should complement the actions of Q#1-8 and as such will be very useful, to the extent that they can get beyond stifling inbred peer review processes that could stymie dissemination of the most useful information and policy recommendations; it is important work to be sure, however some of the issues we face is that these institutions are not trusted so putting out more facts does not always have the desired impact, some people would rather believe conspiracy theories than facts.

9.2 How feasible?

If these could be linked into a collective intelligence network with very broad inclusion and access, it might create the greatest impact, one challenge will be protecting the information from hacking and falsifying; most of these organizations would be managed by more conscious and well-prepared teams that would do the work; requires strong leadership, which is not yet visible; we also need politicians and congresses linked and related to prospective capacity.

9.3 General comments:

There is a risk that AI could dramatically accelerate the impact of disinformation, which will be hard to avoid; important that these scientific associations learn to better communicate with the general population rather than trying to reinforce a kind of elitism, these organizations and their networks definitely need to be part of the process of keeping the world informed about science and technology including AI; good suggestion, broadly speaking, but one should be on guard against the science councils and academies degenerating into scientific bureaucracies, some countries, especially among the less developed countries, have witnessed that happening in the past; I agree that the scientific associations should develop methods and procedures to carry out their responsibilities to establish and communicate scientific facts as AI could dramatically accelerate the impact of disinformation; associations and academies already have some forums to communicate to the public who often are unable to access such information, improving this may require going out into communities, at the street level, on public transportation, through local public services, including health care, public libraries, and government service offices to reach people and to get feedback; I find this an interesting topic, because I often feel scientists are communicating in a way that almost seems to be aimed at having a small number of people understanding what they are working on, what will happen if communication would be more effective and transparent.

Suggested Action 10: Create national policies and standards for the Internet of Things (IoT) that stresses future cyber security systems.

10.1 How effective?

The more things are connected, the more targets for crime, manipulation, and information warfare. See: <https://youtu.be/hqKafI7Amd8>; national policies and standards are good, but more far-reaching and relevant would be international standards; national groups need international coordination; use well-protected blockchains; a wonderful measure to preserve and promote jobs in the cybersecurity field; important, but only as part of an overall solution to taking advantage of technology to facilitate productive and rewarding individual and societal lives.

10.2 How feasible?

Complicated and challenging to develop and get agreement amongst countries, but worth the effort if the policies go beyond stressing future cybersecurity; it is possible to come up with ways to measure aspects of IoT and to help citizens “visualize” its presence around them, what kinds of signals are the IoT units producing and communicating to the network; if adopted, standards and policies can have a large

impact; how well will national policies and standards work in a global world; consensus may take some time; not easy, the subject is very complex for consensus.

10.3 General comments:

Only a handful of big nations are powerful enough to establish and install national IoT policies and standards; organized crime can buy the best software talent money can buy, honorable geniuses are needed; this is the most urgent and important thing where action is needed immediately, it was understandable when Stuxnet type technology encouraged NSA to restrict and even suppress the kind of technology needed to create unbreakable OS's (which existed already in the 1960's!), but after all the leaks, all high-electricity high-internet nations are at risk of losing half their generators within ten years, unless we all move firmly to open transparent machine-verified OS standards, AI simply cannot fix this by itself, to survive, organisms need brains—AND immune systems;

Many, if not most nations tend to start with national standards and then migrate to international meetings to try to agree on international standards. Early in tech development, startups don't like standards that limit creativity, but eventually they each want to be the standard and they need standards to scale up to large networks. The question here is how governments will attempt to ensure security from invasion of privacy and theft from payment systems when many more IoT devices per person will be present in the home and the infrastructure. Standards-setting institutes may need to anticipate and invent new technologies to measure each 'unit of security' or 'unit of safety' or 'unit of well-being' that sellers and consumers alike can use reliably.

Suggested Action 11: National S&T leaders should be part of the national team that creates, regularly updates, and implements their country's national S&T strategy.

11.1 How effective?

Although few read any national strategy documents about anything, the process that creates them can have an impact; S&T leaders should also participate in national and international strategies for education and learning, business and labor, and cultural evolution, too often science has kept too much to itself, at the expense of society; establish "open" procedures to avoid an "enlightened" despotism.

11.2 How feasible?

Seems to me they are already involved, if anyone is listening; should be done based on ethical principles and with good purposes as the WEF does; this is already being done, but the challenge is building the bridges to other disciplines that will facilitate the translation and evolution into future jobs and technologies being easily accepted and taken advantage of by the general population of the world, not just within specific nation states.

11.3 General comments:

This is obviously a practical proposal; depends on the importance and the influence that the political institutions give to the S&T leaders; the national S&T strategies should also

integrate foresight or futures approaches; we need to bridge between the real experts, whose technical language is difficult to understand, and the futurists and politicians that make forecasts of exponential change; the "broader benefits" criterion in deciding what to fund, but top down control and—even worse—top-down specification of science or engineering paradigms, has been a disaster, left brain verbal folks who do not appreciate unique right-brain bottom-up engineers and technical people are another growing problem, multi-way communications are essential; national strategies could be developed in concert with international strategies as technologies operate across many borders, it is time to start operating from a more global perspective as what might be considered good in one country might be considered very negative in another, and unless there is sharing across borders of S&T strategies, those national strategies will become the source of international conflict; even smaller low-income countries should do this, granted they can draw on research by others, but each needs to struggle with these issues in their own context.

Suggested Action 12: Increase R&D in technology to augment humans where possible, to help reduce the impact of technological unemployment.

12.1 How effective?

"If you can't beat them, join them," AI and robotics can be created to augment rather than replace labor, not in all situations, but the more we focus on augmentation rather than replacement the less tech unemployment will occur; this is inevitable and necessary, even if some societies attempt to suppress the technology; this may lead to improve some and leave others behind; it is a great idea, but are we expecting private industry to do this; I think it would be wrong to keep a job that will inevitably be less and less human; redefine employment as the main way of economic survival.

12.2 How feasible?

Many people will do this, in order to stay competitive; what would be the incentive for R&D investments in augmentation technology rather than labor replacement technology; not many countries have sufficient scientists and engineers able to create such augmented workers; unfortunately, some will look at this as a "solution" for the technologically disadvantaged, but it avoids addressing the fundamental problem of unequal access to basic human rights.

12.3 General comments:

R&D in technology is bound to open up newer avenues for technological advancement, changing the concept of employment itself; it is so important to increase R&D in technology to augment humans where possible, to help reduce the impact of technological unemployment; some forms of augmentation will happen, how much will become a biological human-machine interface is not clear, but where some societies will refuse to conduct such R&D, others will do it, in order to gain competitiveness; anyone who believes in technological augmentation of humans should really study the full scope of work by Miguel Nicolelis and be aware of the positive and negative applications of brain computer interface; the effectiveness would depend on the cost of

the augmentation of humans versus the cost of automation of the function; in the not-so-near future, this is also connected to synthetic biology; could this be a cop out on confronting the truth of unequal access to what are internationally agreed upon basic human rights; this is the core of the entire issue: human activities will be disrupted by the AI, robotics, biotech, and quantum revolution, the enhancement of nanotechnology and the 3d/4d printing and what you can't succeed to imagine; the priority to afford a lean passage to this evolutionary jump should concentrate all the energy of the institutional body (private and public) to pursue a shared vision of the future where the advantages will be fully available to everyone not only to the elites or establishment and economical groups, do we have the courage to talk of an unusual form of open source of the benefits that recalls to the most ancient shape of communism, like Universal Basic Income or Universal Basic Property; R&D will always replace or eliminate jobs, companies will try to eliminate jobs replacing functions by machines or robots based on productivity, easy management, and low costs reasons, hence we will need dramatic changes in education to prepare for new jobs, self-employment, services, and implement policies to reduce the time-gap of the process, and to have social policies for the unemployed such as universal income systems, re-training programs, etc.

Suggested Action 13: Support space migration as a long-range insurance policy for human survival.

13.1 How effective?

While the principle purpose of the original space race was political, the benefits from that exploration were enormous in the development and emergence of many of the technologies that we currently take for granted; so, while having it as a long term insurance policy for our human survival, it will also serve to further technological development of all sorts from health to mining, to portable technologies, miniaturizing, transport, etc.; so, full speed ahead! support space migration – yes, but long-range insurance policy is only one reason for this.

13.2 How feasible?

Much of this will have to come from the private sector if it is to happen sooner rather than later, which is what is actually happening at present; it will come by necessity; certainly easy to support space migration, but to have a serious impact by 2050, probably more difficult.

13.3 General comments:

To settle ENOUGH people in space to maintain human survival even after we lose earth would require a whole lot of effective strategic thinking and prerequisites which seem in short supply; the most important prerequisite would be economic sustainability, a natural economic takeoff, which would require more and better export markets from humans in space to earth, energy from space could get us there (a key prerequisite); Mankin's book *The Case for Space Solar Power* (2014) gives a credible new path to 9 cents/kwh electricity available ANYWHERE on earth, dispatchable and switchable, but requires low cost launch, \$500/kg-LEO or less, the US has such technology, but false PR prevents us even maintaining it let alone deploying it, technically it is solvable, but

world technology is going backwards and the human/political risk is daunting, ironically, fake optimism about things which don't actually work is a major tool of those who don't want it to; yes, for no other reason than accelerating technological development in order to make it feasible let alone the other long-range objective of human survival; space exploration and settlement is essential to future wellbeing of humankind—it is feasible and will be highly beneficial (by gaining access to unlimited energy and material resources of space); space migration is too long range a project to have any impact by 2050; a different long-range strategy: a virtual-double of each and every individual as described in a recent Scientific American article on AI—seems to be locked into our futures, but this doesn't fit neatly into this category.

Suggested Action 14: Create solar energy autonomous transporters for free urban individual transportation.

14.1 How effective?

Energy and mobility are the two elements that "pull" most science/technology forward having great social impact; it will certainly improve urban life, but not that much impact on future work-tech dynamics; who pays for these, government, or is there a different business model needed for the development of an ongoing financing of this system, and aren't we already on the way to having these, except without the "free" feature?

14.2 How feasible?

Sounds enticing, but how would it be paid for, and how many government and private sector jobs would be eliminated (taxi and Uber drivers, bus drivers, etc.); this could easily be transformative—in Santa Monica the Bird and Lyme scooters took over the city within weeks of being introduced; remember great population growth will mostly be in cities.

14.3 General comments:

One can visualise the creation of alternate (renewable) sources of energy for running autonomous transportation systems well before 2050, and that it may add to the autonomy of the individual but the extent of work impact is not clear; the technology itself seems very desirable in many communities, improving the environment, reducing noise, increasing traffic safety, and perhaps even reducing traffic volume; not just from individual transport, which just reinforces the over-individualized society we currently live in, but also mini-buses with fixed routes and other mass transit as well or we'll just end up with autonomous transport gridlock instead of driver gridlock; free urban transportation can be a good social policy; important to create solar energy autonomous transporters for free urban individual transportation; existing infrastructure issues, getting consumers on board with AI cars by 2050 is feasible, but other than mega-cities some longer transport options are still needed.

Suggested Action15: Increase investments to automate production and services to free human creative development, allow those less technical to participate in advanced technology, and improve work-life balance.

15.1 How effective?

It would be the ideal world but this may require a more conscious capitalism that may not be so hard to reach at this digital era; a wonderful idea to free human creativity to go back to offering services (paid or for free) if people so desire; this is the best approach, but can we do it, who will do it; this is likely to happen anyway, but how it addresses the issues of future work/tech in the scenarios depends on if or when some form of universal income system is implemented; some automation will actually expand the number of nontechnical people who can contribute to high-tech product and service development in ways that makes it more human and useful; provided there is an adequate discussion of the trade-offs among productivity, innovation, and social equity, I agree that technological development promoted as "social democracy" would allow a better articulation of the human-technology relationship, both in terms of work and social life.

15.2 How feasible?

This would foster more humane development; it could work; there is no consensus yet to create this future, the consensus needs to be built; it will be effective in many situations; there are two different issues here: automation—this is happening and will accelerate; social benefit—this depends on changing the socio-economic system.

15.3 General comments:

It is the rational way to go about it and it is inevitable, but countries with large populations and relatively higher population growth rates, it would be politically unwise to push for automation without reservations, effectiveness or feasibility per se is not the core issue for such countries, their demographic transition has to be addressed before this 2050 picture can work; it depends absolutely on a new education system; how to finance this; will only work if some form of universal basic income is provided to population, taxed from automation systems; this suggestion ignores the economic issues of how to support leisure and only a small percent of people will use more leisure to develop truly creative economically valuable activities and things; already being done, transparent open personnel systems strengthen empowerment of humans, inalienable rights, and people not being property of their employers or clients; include creative economy labs; we have already seen that when we ask people to contribute according to their abilities and to receive according to their needs, the incentive to contribute grows very small and the system collapses, provided automation eliminates demeaning jobs and increases the ability of many more people to participate in the workforce, and there is sufficient compensation to incentivize them to participate, this philosophy of automation will be useful, otherwise, we will end up with societies that, at best, will be bored and non-participatory or, at worst, revolutionary; more tech has not been, nor will it be, a solution to human ills; a virtual-double of each and every individual, personalized to seek on-line information/contacts that build out the real-you person's strengths (or caters to their weaknesses, biases, preferences, etc.) to climb learning and doing

curves quickly and thoroughly - as described in a recent Scientific American article on AI—seems to be locked into our futures.

16 Additional Suggestions from the Panel: What other long-range S&T strategies would better improve work/technology dynamics by 2050? [Some suggestions were not included that were comments not actions, and other suggested actions covered in one the four other Real-Time Delphi studies that will go into the final report.]

- Integrate S&T policy issues for far more attention into the discussion of education and culture worldwide.
- Research how to transition from the global political economy seeking infinite growth through accumulation to an economy for creating a more decent life for all within planetary boundaries.
- Conduct research to create an algorithm that would encourage continued use of humans in industry and business by cutting their cost of employment by two means: 1) find the most efficient way to move the social safety net/welfare costs, such as social security, medical insurance, maternity leave, disability (unless directly safety related) and care, and so forth, from the employer to the government; and 2) find a method that does not decrease efficiency to tax the output of automation/robotics to cover the increased government costs of the social welfare.
- Increase research and attention to pursue the full scope of natural human potential and collaboration.
- Explore options for creating a fintech driven universal basic income engine that self-funds based on automatic taxation of online commerce.
- Identify better mechanisms than the profit motive and government support to allocate resources to technology development and creation of problem-solving systems. For example, improve channelling of philanthropy to develop constructive capabilities, as Bezos, Musk, Allen, et al. are demonstrating.
- Apply S&T and social engineering to replacement of jobs with more fulfilling work.
- Make smart phones a right of citizenship complete with a full-service provider and energy system such as a heat-battery that uses solar and waste-heat for storage.
- Create a cryptocurrency/blockchain-based new economic global system with incentives for improving the life versus maximising corporate profits; this would progress slowly at first but could be synergistic with many good initiatives.

- Invest in R&D that lets anyone create their virtual-double to seek on-line information/contacts for personal development as described in a recent Scientific American article on AI.
- Require government statutes, regulations, and ordinances to meet the same high standards of research, design, cost-risk analyses, and follow-up evaluation that are now routine for some physical products like pharmaceuticals, aircraft, nuclear reactors, etc.; the objective would be to create and maintain bodies of laws that optimally serve the best interests and wellbeing of the people (e.g., as measured by human rights, living standards, quality of life).
- Tax robots.
- Extend ISOs in the power sector as an antidote to the many private and public top-down 1-player control systems.
- Create different work/tech scenarios: one each for low income, middle income, and higher income countries, and the correspondences between these.
- Initiate a worldwide bottom-up basic income movement and system that is not handled by nation states but individuals. This could be funded both by wealthy individuals and crowdfunded by individuals. An option would be to try this out in small communities, then slowly roll it out. The idea is partly inspired by the German example of "Mein Grundeinkommen" (My basic income), where basic incomes are crowdfunded and then distributed via lottery. It was founded by an individual who felt lucky that he had time and income on his hands due to having sold his company shares after co-founding a successful start-up. See here: www.meingrundeinkommen.de.
- Improve S&T collective intelligence systems and foresight/futures related processes.
- Merge mystic attitudes with technocratic management.
- Increase R&D in genetic research, life extension, and space travel.
- Explore how to transmit part of the savings due to new technologies to people that are working in more traditional care-taking work that have a major impact on human wellbeing.
- Promote dialogue strategies between government, society, and companies for free access to technological developments that improve the quality of life of citizens.
- Counter-balance the industrial negative ecological developments by international alliances of public bodies, decision-makers, and academia.

- Apply S&T to learn faster: 1) "quick learn" techniques that could be applied to all sorts of complex domains, speeding up climbing the learning curve; 2) the application of "quick learn" to game making (not game playing), increasing the retention rate and levelling the playing field across the various student populations; 3) the introduction of dense reading material at 11 or another early age (e.g., "Conquering the Physics GRE" a GRE Preparatory Book, "Cracking the GRE Chemistry Test", etc.); 4) the diversity of symbolisms associated with a wide range of advanced Math (e.g., "Divs, Grads & Curls" to go with Maxwell's Equations, Einstein & Riemann notations to go with Special Relativity and Gravity, general symmetry equations to go with Weak Fields relationships, etc.) should be introduced far earlier in each of the various learning programs; 5) the teaching of Physics (including the Physics' Math) first, Chemistry second, and Biology last is the appropriate order including the relevant math to each; and 6) the teaching of origami as a sufficient precursor pathway for a career in Synthetic Biology.
- Explore how gross expenditures on R&D could be more democratic.
- Insure that S&T R&D integrates the principles of responsible research and innovation even in the early stages and encourage scientists and engineers to cooperate with experts in social sciences and humanities to anticipate future impacts of the developments.
- Assess the broad impacts of an expanded space program.

Parting comment from a participant: Thanks so much for the ideas presented in this document, hoping all the best for the future.



Conclusions

We need think globally and long-term about the future of work-technology dynamics. Globally because if your country does everything right to make a relatively smooth transition to the next economy, but your neighbors do not, mass migration from your neighboring countries to your country is very likely. And thinking long-term forces us to consider cultural changes that may result initially from artificial narrow intelligence, robotics, and drones, to the more distant possibilities of artificial general intelligence, quantum computing, and the proliferation of thousands if not millions of new life forms from synthetic biology.

Of course educational change is called for, but so are changes in government, business, S&T research, and the purpose of work. Thought leaders have described many of the future challenges we face in this transition, but equal time should be given to describing what we do to make the transition better. While doing the research for scenario 3 on the self-actualization economy, it became clear that no country had done a cash flow projection to show when and how a universal basic income was financially sustainable. We should give equal time to this financial analysis as many have to the moral justification for it.

As a generalization, technological capacities improve faster than people think, but their application takes longer than seems reasonable. For example, the Internet protocol was created in the late 1960s, but serious public attention to the Internet did not begin until the 1990s. However, this generalization may be less valid in the future because we now have the Internet with over half the world connected to it, and AI applications are spreading very fast making it easy to share and apply new technological capacities worldwide much faster than in the past. Hence, we have less time to adjust to change. We can buy more time, if we look further into the future of possibilities. This widens the time gap between now and those more distant possibilities, described in the three 2050 global scenarios.

As everything seems to becoming more complex, it is reasonable to assume that the actions to address this transition may be complex as well. We will need many things to be done, by many different people and institutions with different interests and skills. We many not need to do all 94 actions assessed by the international panel and many of the additional 118 suggested actions, but we do have to do more than just get STEM into more educational systems. This report offers a more holistic, international, and long-range approach to addressing the future of work and technology that what is currently offered worldwide. We hope it has broadened your thinking and given you a rich menu of actions from which to select to improve your impact on tomorrow.

