International Academy for Quality

Prognostications
Scenarios of the Future as Viewed in 2011

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Prognostications: Scenarios of the Future as Viewed in 2011

Gregory H. Watson
Chairman and Academician, International Academy for Quality
Past-Chairman and Fellow, American Society for Quality

Introduction

What does the future hold? Despite a stereotypical image, futuring or studying the future is not about 'fortune-telling' and one does not use a crystal ball to study the future. While it is not possible to forecast exactly what the future will bring, it is still possible to think ahead and learn about what actions should be considered as the future unfolds. One way to anticipate potentialities for future options in decision-making is to conduct studies of the future. Combining sound data research with expert opinions about the most likely factors to impact the future, it is possible to design alternative scenarios that represent a spectrum of possibilities. While these states do not represent a forecast anticipated to become true, studying how to respond to these scenarios can help to better cope with the unfolding future and prepare a flexible response to risks exposed within these scenarios.

This approach to the future is supported by the process of scenario writing. It begins with research to understand the long-term trends (20-50 years) upon which the medium-term (10-20 years) trends are superimposed. These long-term trends should be discoverable by scientific data analysis of physical, biological or environmental factors to uncover critical elements that may be hidden in short-term and medium-term observations. The long-term trends impact all scenarios in medium-term; however, the actions taken in the medium-term may serve to mitigate the magnitude of risk that is faced. Application of the Delphi technique helps identify likely forces that drive medium-term change and a spectrum of scenarios is used to expose alternative ways in which these forces operate under a range of potential conditions.

This paper traces development of the scenarios prepared to support the 2011 Future Study by the American Society for Quality (ASQ). It describes long-term environmental factors, explains driving forces of change, defines four scenarios for medium-term future states, and proposes dynamic changes anticipated in the driving forces as the scenarios shift across the spectrum from most optimistic to most pessimistic future potentiality.

Long-Term Dynamic Factors

Long-term (20-50 year horizon) factors relate to fundamental existence needs of mankind for an adequate food supply, clean air, pure water, favorable climate and energy supply as Earth's population continues to expand. These factors are not fixed but operate across a dynamic range and consequently must be studied using probability-based models that consider the most likely outcomes of a range of input factors. First, we shall consider the evidence from observations about these effects that are driven by population expansion and then we will look at outcomes of the simulation models to understand the future implications of these observations. A recent article by the American Association for the

Advancement of Science (AAAS) observed the impact of continued population growth on food production: "The world likely will need to double food production by 2050 to meet rising food demand, and investments alone won't be enough to meet that goal." According to the National Institute of Food and Agriculture at the U. S. Department of Agriculture: "Because we do not feel the hunger that gnaws at nearly a billion of the world's citizens and because the few American farmers that feed American and much of the world are often out of sight and out of mind of urbanites, we have become complacent in the support and advocacy for agriculture research." [1]

This global food shortage is created by the demands of an increasing global population (see Figure 2) coupled with environmental changes creating (e.g., impact of drought). In the same period world population concentration will shift to "megacities" (cities with over 10,000,000 residents). In 2010 there were 26 megacities, but by 2025 it is forecast that there will be 600 megacities and they will generate over 64% of the global GDP and also will be the dominant consumer of energy. [2] How will the food and water supply chains support such population concentrations? Concentration of large populations in such megacities will likely also increase levels of air and water pollution and exacerbate related problems such as energy poverty, inequitable wealth distribution, as well as shifting demographic issues related to healthcare and educational requirements.
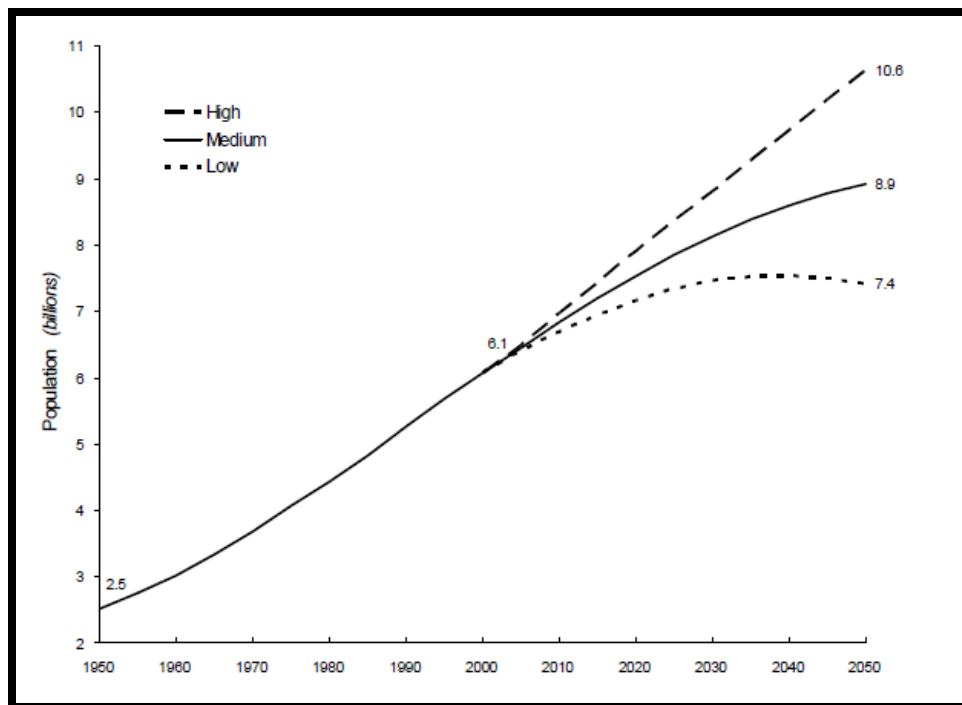

Figure 1: UN Estimates for Global Population Growth [3]

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[1] Edward. W. Lempinen, "Experts Urge Renewed Research to Meet Global Food Needs," *Science*, Vol. 329, 30 July 2010, p. 527.

[2] James Canton, "The Extreme Future of Megacities," *Significance*, 8:2, 2011, 53-56.

[3] United Nations, Department of Economic and Social Affairs, *World Population to 2300*; downloaded from: http://www.un.org/esa/population/publications/longrange2/WorldPop2300final on 15 July 2011.

In addition to this forecast for continued population growth, evidence continues to build that identifies climatic change as a work in process. For example, NOAA recently published an academically peer-reviewed state of the climate report for 2010 which analyzes trends in 41 climate indicators. NOAA concluded that the world is continuing to warm. Key findings from this report include: the world's mountain glaciers have lost mass for the 20th consecutive year; Greenland glaciers lost more mass in 2010 than any other year on record; Arctic sea ice shrank to its third smallest area on record; and average sea level has continued to rise across the world's oceans.[4]

All these factors identify that our natural, sustainable environment is currently threatened more dramatically than it has never been before in the history of mankind. In the early 1970s the Club of Rome commissioned Dana Meadows, Dennis Meadows, Jorgen Randers and William Behrens to conduct a computer simulation study which became *The Limits to Growth*, a book that raised the alarm to the global long-term consequences of a rapidly rising population in a world with finite natural resources. In a twenty-year follow-up to this initial alert, the authors produced reproduced the analysis of their initial scenarios and published the result in 1992 in *Beyond the Limits*. The results were not encouraging and the study predicted a collapse in global systems as they exceeded the limits to growth.

However, such predictions are not certain. Consider what happened to those concerns that were raised in the late 1980s about the ozone depletion in the atmosphere. At that time the "ozone hole" above Antarctica increased the credence of the original Club of Rome report and the *Limits to Growth* study methodologies. [5,6,7]

What happened to the ozone layer? In 1986 choroflurocarbons (CFC) were recognized as the culprit for depleting the ozone in the Antarctic; however, the level of CFC's continued to build in the stratosphere (despite CFC regulation and elimination from production by 1997) due to atmospheric mixing that delayed the journey from the earth-bound release of CFCs in their migration to the stratosphere. Mankind's progress in this area of unintended attack on the world's environmental system was reported in *Limits to Growth: The 30-Year Update*.[8] This global transition was successfully mediated by the United Nations Environment Program (UNEP) which collected the scientific data, assembled the evidence, hosted the political process, presented the case to governments, and acted as an objective mediator to obtain global consensus and action. From the first

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[4] Downloaded from: http://www1.ncdc.noaa.gov/pub/data/cmb/bams-sotc/climate-assessment-2010 on 15 July 2011.

[5] Donella H. Meadows, Dennis L. Meadows, Jorgen Randers and William W. Behrens III, *The Limits to Growth* (White River Junction, VT: Chelsea Green Publishing, 1972).

[6] Donella H. Meadows, Dennis L. Meadows, and Jorgen Randers *Beyond the Limits* (White River Junction, VT: Chelsea Green Publishing, 1992).

[7] For an interesting history of the development of environmental sensitivity read: Alan AtKisson, *Believing Cassandra: How to be an Optimist in a Pessimist's World* (White River Junction, VT: Chelsea Green Publishing, 1999).

[8] Donella Meadows, Jorgen Randers, and Dennis Meadows, *Limits to Growth: The 30-Year Update* (White River Junction, VT: Chelsea Green Publishing, 2004), pp. 181-202.

scientific data presented in 1985, it required a series of meetings to change this situation (Montreal in 1987, London in 1990, Copenhagen in 1992, Vienna in 1995 and Montreal in 1997). By 2010, scientists have observed a downturn in the rate of growth of the inorganic chlorine and bromine concentrations in the stratosphere due to CFC emissions and a slight improvement in the ozone layer. But, it is not anticipated that the ozone layer will recover to its pre-1950 level until the mid-21st century due to slow migration of these substances from Earth to the outer limit of the stratosphere. Such delay in recovery of the global ecosystem creates an imperative to reverse such effects as early as possible.

However, the success with ozone management has not been replicated in other gases that have deleterious impact on the atmosphere. For example, in 1997 the UN Kyoto Protocol recommended global management of six greenhouse gases (GHG): carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC's), perfluorocarbons (PFC's), and sulfur hexafluoride (SF_6) that have a warming effect on the climate when released into the atmosphere.[9] Many of these gases are released in processes that are anthropogenic, caused by human actions rather than natural forces, and thus subject to human control by policy and technology. Even though these protocols enforced in 2005, they are limited in comparison to efforts for CFC management as they do not specify targets to achieve or an agreed schedule to achieve reduced emission levels. In fact, while the level of atmospheric CFC is observed to improve, the levels of Carbon Dioxide, Nitrous Oxide and Methane continue to increase as shown in the 2010 National Ocean and Atmospheric Administration (NOAA) Annual Greenhouse Gas Index (AGGI) below:
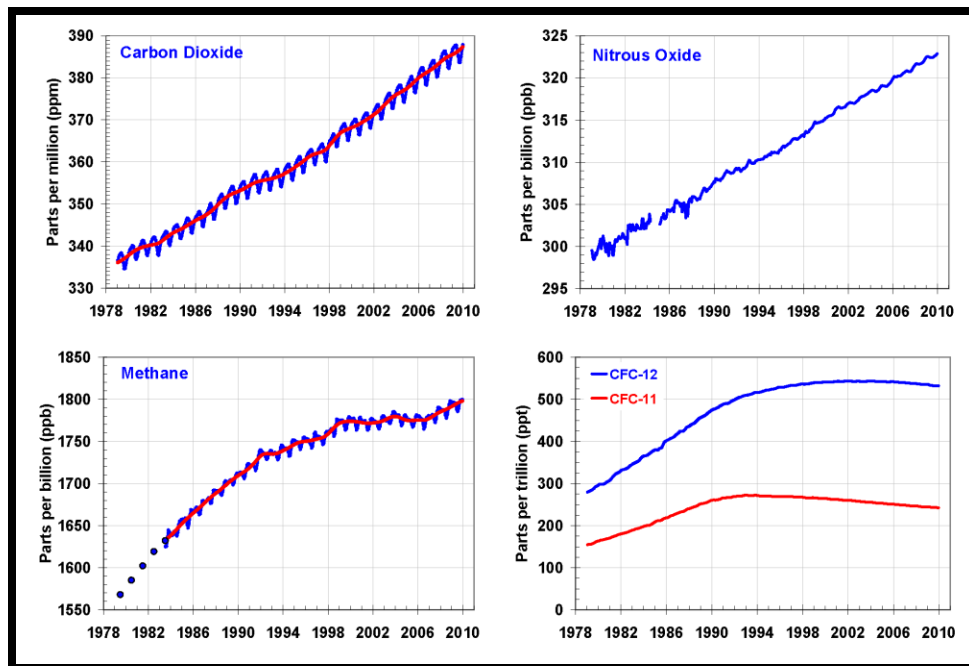

Figure 2: NOAA Reported AGGI for 2010 [10]

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[9] The Kyoto Protocol implements the international environmental treaty for stabilizing greenhouse gases in the atmosphere – the United Nations Framework Convention on Climate Change (UNFCCC).
[10] Downloaded from: http://www.esrl.noaa.gov/gmd/aggi/ on 15 July 2011.

Although the US did not accept the Kyoto Protocol it is a signatory to the basic treaty, the United Nations Framework Convention on Climate Change (UNFCCC). But, the Kyoto protocol is not comprehensive as it does not specify limits for all gases known to influence climate change, so its impact on GHG cannot be comprehensively described. Due to its lack of ratification of the Kyoto Protocol, the US must also accept some moral culpability as it produces 36% of all global GHG emissions. The current level of state and city GHG emissions is reported by the Environmental Protection Agency (EPA) annually in its Greenhouse Gas Inventory. [11,12]

In 2001, President George W. Bush requested that the National Academy of Science (NAS) assess the current state of our understanding about the sources and mechanisms of climate change. A final consensus report by America's leading scientists was published in 2008. Based on twenty-nine detailed observational studies that investigated all aspects of the climate change mechanisms, NAS concluded that "human activities are changing the climate." This final consensus report by the National Academy of Science is highly recommended reading for anyone who is concerned about the future of our world. [13]

In addition, conclusions drawn from by the *Limits to Growth* studies provide sobering insights into implication of these global changes as it forecasts the environment to change in the coming decades. The briefest summary of the lessons learned is that the current way of life on Earth is unsustainable. Perhaps this is the theory behind the intellectual contributions of Karl Marx and Vilfredo Pareto.

Karl Marx divided society into two classes: those he labeled as bourgeoisie whose wealth is measured by capital while those he labeled as the proletariat class which is struggling economically and considers their wealth in their children (does family values strike a familiar chord?). Vilfredo Pareto noted that 80% of the world's wealth was possessed by 20% of its inhabitants. Thus, we may conclude that 80% of the world's inhabitants are members of the proletariat class or are part of what some nations call a lower class – the 'ultra-poor' class. One side effect of the growing desire for democracy is that the promise of improved quality of life comes with it – the ability of individuals to self-determine the value proposition of their lives. It is a promise that drives 80% of the world's population in a desire to improve their living conditions so they are included in the 20%.

Striving for increased standard of living becomes a reinforcing activity – more wealth

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[11] Under the Clean Air Act the Environmental Protection Agency (EPA) monitors the air quality level of six airborne pollutants: nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), particulate matter (PM), carbon monoxide (CO), and lead (Pb). Data from 4,000 instruments distributed across the United States are maintained in the AirData statistical and mapping data base (http://www.epa.gov/air/data/index.html) and may be accessed for researchers or the public to conduct their own studies of air quality for a local, regional or national geographic area.

[12] Environmental Protection Agency, *Inventory of U. S. Greenhouse Gas Emissions and Sinks, 1990-2009*, 15 Aril 2011, downloaded from: http://www.epa.gov/climatechange/emissions/downloads/   on 15 July 2011).

[13] National Academies, *Understanding and Responding to Climate Change* (Washington, DC: 2008).

drives the desire for more wealth. When people attain more wealth, then the effect is to decrease population as they shift in class status from bourgeoisie to proletariat and seek to conserve their wealth and protect their achievements. Thus, growth in monetary terms is a motivator behind all of the scenarios in the *Limits to Growth* and the only way to prevent this driving motivation is to change the expectations of society so that the value we share becomes austerity rather than riches and a flamboyant lifestyle. Without such a change the result of scenarios described in the *Limits to Growth* is overshoot of environmental stabilization and a collapse of the global ecosystem. This is the likely outcome "*if* the policies that influence economic growth and population growth in the future are similar to those that dominated in the last part of the twentieth century, *if* technologies and values continue to evolve in a manner representative of that era, and *if* the uncertain numbers in the model are roughly correct." However, in a sensitivity study of the World3 model inputs, the investigators discovered that changes in the inputs would only delay the timing of the outcome, and would not actually change the effect itself. [14]

So, where does this leave us? In summary, the facts have been collected and we have a general understanding about potential future disasters that we may face, but somehow mankind is in a quandary about what to do about them. It is as if society were a deer caught in the headlamps of an oncoming car! Our leaders argue inconsequential political points and play a "blame game" but they do not focus on delivering real solutions to our real problems – to affect a transformative break in negative cycles that are creating a doom loop in our pursuit of ever-expanding economic growth as the primary indicator for quality of human life. Thus, from our investigation of long-term environmental factors that affect future possibilities we can draw three conclusions:

- Many thoughtful researchers and scientists have been toiling for years to observe and report on the disintegration of our intricate web of natural systems that have supported the Earth (this is a fact established through numerous studies conducted by the National Academy of Science).
- Our most important global ecological systems are deteriorating rapidly, perhaps too rapidly to prevent their collapse (based on extrapolated simulation scenarios from the *Limits to Growth* studies).
- Unpopular political alternatives have paralyzed lawmakers increasing the burden they feel from these conclusions and causing them frustration and hopelessness as the decisions they face are not aligned with the promises they have made to their constituencies. Thus, the easiest path forward is to ignore long-term problems and focus our concerns on short-term issues. Our elected officials lack political will to heed the distress signals detected by our scientists and no longer want to hear any more bad news about the environment. In effect, they are following the culture of our television and Internet age by saying: "please change the channel or surf to a different site; I don't want to watch this depressing show any more!"

The time has come that somehow society must change the conventions by which it has come to operate. However, before we draw any conclusions about the future we must do

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[14] Meadows, et, al., *Limits to Growth: The 30-Year Update*, p. 171.

a more thorough assessment of these alternative possible futures in order to determine the obligations of the global quality community for encouraging necessary transformations. The nature of the transformation required is a change in our expected outcomes as well as a change in our commitment toward the common good of mankind and this will require mankind to set new public policy as well as attain more altruistic motivation behind our individual and collective actions.

So, the present challenge is to use this information as a foundation to define a set of four scenarios for this current ASQ Future Study. We must look to the outcomes of these scenarios to answer two fundamental questions: (1) what can we do to prepare for the impact of the forecast changes, and (2) what steps can be taken to inhibit or reverse the forecast? But, first we must define the context that we will use in our scenarios to specify the long-term influence of these environmental effects of population growth.

Long-Term Scenario Assumptions

Just as the scenarios postulated by **Limits to Growth** studies have illuminated our current environmentally-induced crisis that has been caused by population growth, enhanced by a desire for increased quality of life by all societies, and exacerbated by the unintended set of consequences from environmental pollution, can we create scenarios for the future of quality that achieve a similar enlightenment about the role that quality will play within both the short-term forces of change as well as the long-term cycles of environmental change that may be forthcoming?

The scenarios for the future this year incorporate both the medium and long-term factors for consideration. Long-term factors driving these scenarios are based on permutations of the global environmental possibilities. The medium-term factors will be based on the forces of change that were generated by participants in an ASQ-sponsored Delphi Study. The combination of these factors will define the four scenarios presented in this paper.

To create a spectrum of long-term possibilities the scenarios will use permutations of two factors: climatological change and solar pacification. While the background for climate change has been already described, it is important to describe what is meant by solar pacification and what impact it should have over the long-term scenarios.

Recently, astronomers have observed changes in the activity level of solar bright spots, commonly called sunspots or faculae. Sunspots are thermal leaks in the solar surface which allow sub-surface solar energy to escape leading to an overall increase in radiated solar energy. This leakage appears as a surface effect or a dark spot on the sun. Sunspots have been observed visually by astronomers since the 1600s and a history of recorded observations is shown as Figure 3.

Earlier sunspot records are postulated based upon the climatological effects on surface phenomena. This chart illustrates a short-term cycle of 11 years for sunspot activity where a maximum was forecast for 2010-2011. However, in a report from the National Solar Observatory (NSO) in May 2011 stated: "As the current sunspot cycle, Cycle 24,

begins to ramp up toward maximum, independent studies of the solar interior, visible surface, and the corona indicate that the next 11-year solar sunspot cycle, Cycle 25, will be greatly reduced or may not happen at all." [15] The outcome of such an occurrence is a very chilling effect.
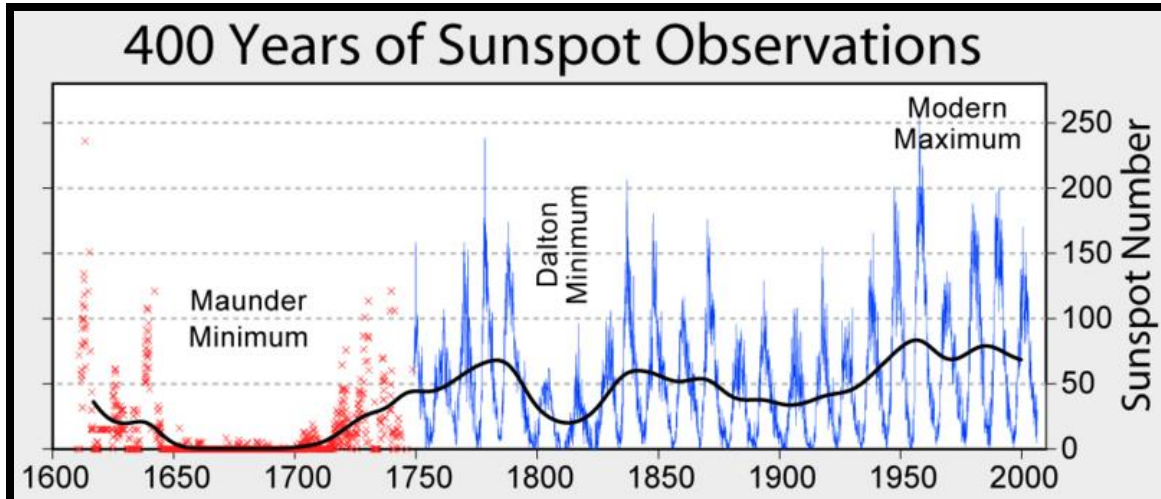

Figure 3: Sunspot Activity Cycle [16]

The period 1645-1715 is known as the Maunder Minimum (after discoverer Edward W. Maunder (1851-1928) who discovered this period of minimal sunspot activity which also corresponds with the coldest recorded temperatures in Europe over the past 500 years (an observed decrease in average winter temperature in the range of 3-7**°**C from England to Russia. Note that this study also found the highest average winter temperatures in the past 500 years in the last decade of the 20th century.) [17]

In two prior cycles (1420-1570 and 1790-1830) such cooling effects were also related to decreased sunspot activity and this has led to an evolving theory relating sunspot activity as a potential cause global cooling and possible reason for the advent of the Ice Age. During such periods the Earth is highly susceptible to global climatic influence. For example during the last solar minimum Mount Tambora (Sumbawa, Lesser Sunda Islands, Indonesia) erupted (in 1816), measured on the Volcanic Explosive Index of 7.[18] This was the largest volcanic eruption since 180 AD and it caused less sunlight to pass through the Earth's atmosphere, resulting in global cooling in what is popularly called the "year without summer" and the proximate cause for a global famine due to these combined effects. Winter temperatures in New York dipped to – 34**°**C which reflects temperatures

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[15] American Astronomical Society, Solar Physics Division media teleconference 1100 MDT, 14 June 2011.

[16] Downloaded from: http://en.wikipedia.org/wiki/Sunspot on 15 July 2011.

[17] Jurg Luterbacher, Daniel Dietrich, Elena Xoplaki, Martin Grosjean and Heinz Wanner, "European Seasonal and Annual Temperature Variability, Trends and Extremes Since 1500," *Science*, 303:5663, 5 March 2004, pp. 1499-1503.

[18] The strongest volcano during the last century was the eruption of Mount Pinatubo (Luzon, Philippines) in 1991 which measured 6 VEI while the Mount St. Helens, Washington eruption of 1980 was measured at 5 VEI.

found in the coldest winters of Northern Finland. [19]

Thus, three conditions will be considered over the long term in the quality scenarios. The factors selected for these permutations will be: human population, environmental effects, and political response. These factors will be applied in the scenarios as follows:

- *Human Population*
  - *Unrestricted Population Expansion*: human population continues to grow as predicted by the UN at the high level from 6.1 billion in 2010 to 10.9 billion by 2050.
  - *Stabilization of Population Growth Trend*: human population maintains a constant growth pattern and reaches 8.9 billion by 2050.
  - *Stabilization of Human Population*: human population growth decreases to a level where the population is 7.4 billion by 2050.
- *Environmental Effects*
  - *Solar pacification*: hibernation in sunspot activity occurring during a solar minimum will be endured for 50-150 years and will decrease the average temperatures 3-7°C, however, at the end of this cycle the solar activity will return to normal and this effect will disappear.
  - *Climate Change*: anthropogenic climate change will cause temperatures to increase 2-4°C and this effect will be need to be managed over the long-term, even if it is offset temporarily by solar pacification.
- *Political Response*
  - *Enlightened Response*: a coordinated global political response focuses on attaining total environmental stabilization by anticipating the impact of all projected destabilizing factors and collaborating to apply the technological resources of all nations to achieve an equitable utilization of the Earth's natural resources.
  - *Scientific Response*: a coordinated global political response focuses on the mitigation of scientifically proven and politically accepted factors that are demonstrated to adversely impact environmental factors that are essential to maintenance of human life under managed developmental conditions.
  - *Dysfunctional Response*: political divisions between the developed and undeveloped nations inhibits agreement and coordinated action to address the situation until such time as it is obvious to mankind that humanity has passed the tipping point and is no longer capable to muster a coordinated response to the environmental crisis.

One outcome of future studies should be to influence the choices that can be made for varying political policy response. Changes chosen by politicians will either support or reject coordinated global action to scientifically-demonstrated evolving critical conditions that influence the environment. The reason for the choice of conflict between developed and undeveloped nations is due to the continuing global trend to embracing a democratic dominant form of government. This trend is obvious when we observe that at the start of

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[19] Reference: http://en.wikipedia.org/wiki/Volcanic_Explosivity_Index.

the 20th Century only 25 nations comprising just 12% of the world's population lived under some form of democracy; by mid-century this had grown to 42% of the world's population and by the end of the 20th Century electoral democracies represented 120 of 192 countries, constituting 63% of the population (3.9 of 6.1 billion people). As democracy spreads expectations for an improved lifestyle increase as the constituents of these nations pursue economic freedom as well as political freedom. This in turn raises the demand for consumer goods and housing which can influence environmental cycles.

Some of these forces will have a stronger influence on alternative future scenarios than others. This represents the dynamics and interconnection among the forces as we have learned that success in taming consequences of one poorly performing factor does not assure a successful outcome for all the forces. Some forces represent the hygiene factors or basic needs of life for air, food, water, shelter, warmth, safety, security, stability, protection, etc. These represent fundamental requirements of human existence. Other forces are influenced by the cultural, social, psychological, and emotional needs we have as humans. If the first set of factors is not satisfied, then the second set of factors will not be relevant.

We believe that these forces will differ in impact depending on the developmental progress of society. It is only natural that developing nations will focus on achieving sustainability of the forces that are influenced by the hygiene factors, while developed nations will focus on those forces that increase personal growth and recognize achievement and the prestige of accomplishing one's full potential. Strongly coordinated political will is needed to balance the current structural disparity and assure equity of opportunity for all mankind.

Medium-Term Forces of Change

While the long-term forces of change will probably require transformation over the long-term, the medium-term forces of change are different. These forces declare that "changes in the world have become so great that we can no longer rely on our historical policies and old ways of working to operate any longer." We now recognize the inevitability of change in the short-to-medium-term horizon. Change will happen. The question we must answer is: can we harness the positive ideas and capabilities of mankind to combat the systematic impact that poor past decisions have had on the environment and our global economy? What are the forces that our panel of experts believes will drive the future?[20] In rank order, the forces named to be most significantly shaping the future of quality are:

> 1. Global Responsibility
> 2. Consumer Awareness
> 3. Globalization
> 4. Increasing Rate of Change
> 5. Workforce of the Future

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[20] The Delphi study conducted by ASQ in 2010 engaged 149 global quality professionals to discover their insights into what is driving change and developed a consensus position. Of the participants in this study 59 were members of the International Academy for Quality.

      6. Aging Population
      7. 21st Century Quality
      8. Innovation

Understanding the Driving Forces:

Note that these forces will manifest differently in each of the scenarios described below. To understand how these forces influence change across the scenarios, we provide the following baseline definitions of these driving forces to facilitate understanding of their nature, aid in comparing and assessing their relative impact as they change across the scenarios, and permit future study teams to track the evolving cross-study lessons learned.

1. Global Responsibility

Global responsibility combines social responsibility with environmental responsibility and good governance with a growing awareness of the global impact of local decisions. Our planet's finite resources are being called upon by a rapidly growing population, and waste that was once economically acceptable is becoming socially unconscionable. The breadth of global responsibility spans governance, human rights, labor practices, fair operating practices, environment, consumer interests, and contribution to society as described by ISO 26000 [supplemented by guidelines for risk management (ISO 31000)]. Global responsibility is a call to ethical leadership at all levels of society – governments, organizations, schools, civic organizations, neighborhoods, families, and individuals. It asks that we develop and execute the means to increase our responsibility.

Global responsibility engages a broad war against waste. Waste is a loss incurred by society from any misused or underused resources, including people. The dimensions of waste are economic, risk-based, and operational and include flexibility to conduct zero-based budget considerations of sunk costs in order to formulate the best possible use of resources for the future based on needs, rather than a continuation of historical programs and allocations. However, as resources are scarce, prioritization of their allocation is essential and must include minimization of waste through responsible design and the obligation for stewardship across the full product lifecycle. Innovation must advocate sustainability. An innovation without a decreased cost to society is irresponsible.

The definition of waste will become more encompassing and future measures of waste may include waste from poor use of material in design, waste of human potential, and the cost of unethical conduct on the lives of those affected. All these costs and consequences are avoidable through improved awareness of risks and management of countermeasures during design and development. Another waste is the waste of humanity that comes from undeveloped minds; lives lived without purpose and the lost contributions to society that would come with the full engagement of all people living worthwhile lives.

2. Consumer Awareness

Consumer Awareness is about consumers obtaining a power edge in the market by using

their knowledge to make purchasing decisions that are best aligned with their preferences. Before the Internet, consumption was primarily limited to locally available products and services. Today consumers can "shop" around the world, and they can use Internet knowledge to inform their decisions not simply related to the product/service itself, but also the practices of the company. If the Internet made knowledge *widely* available, social media is making information *instantly* available. Consumer behavior moves at "speed of electrons" in both positive and precipitously negative directions. Providers will find themselves needing to respond at similar rates to the collective behavior of customers.

Closely related to the rise of consumer awareness is the ability for consumers to match requirements with attributes of deliverables to improve attractiveness of their offerings. Organizations that create the greatest flexibility for creating products and services to match customers' exact wants and needs will be rewarded. Service providers are already headed this direction as they tailor experiences to custom fit their customers. Their databases and the massive data bases available to them allow them to capture customer preferences. Flexible manufacturing permits mass customization of products to local markets. Economically order quantities of one and zero waiting times will be the rule.

3. Globalization

Globalization is the only force that has been consistently identified in ASQ studies since 1996. It was top on the lists in 2005 and 2008. Its influence was twice that of next force on the last study. However, its meaning has shifted since 1996 when globalization was perceived as an opportunity for developing companies to capitalize on new and emerging consumer markets. By 2005 global market opportunity was offset by fear of competition due to lower labor costs. What seemed certain by 2008 was either way – opportunity or threat – globalization is a reality. Those that ignored globalization did so at great risk.

A neutralizing factor to globalization is the need for local production caused by a sense of social responsibility. Why buy produce shipped halfway around the world, even if less expensive, when locally grown alternatives could significantly reduce packaging, transportation, and energy consumption?

Today global customers and global supply chains occupy a greater share in organizational strategy. Risk and opportunity are huge and executives and governments are reeling in response to issues that are no longer bound by national borders. Complexity has new meaning – or, better said, human minds struggle to make meaning of the complexity they face. If that's not enough, complexity is certain to increase. Increasing the challenge for managing opportunity and risk in globalization is the need to manage enterprises across borders, cultures, and economic developmental stages and the fact of finite resources.

4. Increasing Rate of Change

The rate of change is accelerating and it has moved from a background force in past future studies has been the issue of spot the front of the list. In fact in 1999, when we reviewed the findings of the 1996 study, a common comment was, "the only thing we

underestimated was the rate of change." In that study we referred to the factor as speed. The increasing rate of technological change also brings opportunity and threat. High amongst the threats is society's inability to adapt to the changes foisted upon us by new technology. New technology could create consequences if we fail to imagine how to use it effectively. On the opportunity side of technology are solutions to world problems. Energy, pollution, fresh water, food, housing, and health are all on our list of hopes for future technological solutions. Without solutions to these problems, our dream that the future can provide our children a quality of life equal or greater than our own is doubtful. If population growth was the driver of economic success in the last century, it will have to slide over as technology takes the wheel in the 21st century. However, technology is a much less predictable force than population growth. Technology is certain to surprise us in ways that disrupt our status quo.

Futurists are already predicting that nanotechnology will have a more significant impact on our lives than the Internet, and other technologies are coming that we haven't even labeled are rapidly following. Information technology will continue to impact our life as cloud computing and data ubiquity change the way we operate and make computer costs more affordable and cause massive processing power to be better coordinated. Six years ago one terabyte of data storage cost approximately $100 (USD) and it was the size of a small handbag. Today two terabytes can be purchased for the same price while the size has reduced to the footprint of a cellular phone!

Product lifecycles have become increasingly shorter for decades. Today, many consumer electronics have development lifecycles of six months or less and they are projected to become even shorter in the future. Industries will be born, become significant in our lives, and disappear with increasing rapidity. Being first to market will win the advantage and there may be little opportunity or time in the market for second place. Emphasis on speed will require organizations to better anticipate the future and be prepared to respond to the customer's feedback in lightning speed. The cost of missing any market cue, at today's speed of information sharing, could be disastrous for producers.

5. Workforce of the Future

The Workforce of the Future will challenge our current notions of functional talent, the nature of work, the operation of the workplace, and channels and means of learning. In such an environment, unemployment, as we currently define it, may become a thing of the past as the number of jobs available will exceed the number of competent people to fill them as the population profile of the world shifts. Currently demographers predict that organizations will find themselves competing for talent and that competition will move jobs around the globe. High tech companies already experience this reality. This search for talent, along with technological advances will change the nature and place where work is done and organizations will grow increasingly flexible in their definitions of work engagements. Those of retirement age will be re-attracted to continue working but with flexible hour arrangements and so that work can be done without commuting.

The rapid information expansion (doubling every 18 months) drives the acceleration of

technology and pressures organizations to increase workforce knowledge. Lifelong learning will gain new meaning as learning change to develop just-in-time education. Education will evolve so that everyone will need to be both a learner and a teacher. However, a counter theme to knowledge growth is our ability to forget past wisdom – and this also seems to be accelerating. A challenge in educating the workforce of tomorrow is to preserve the wisdom of the past and build on it, gaining new insights rather than to continue to treat knowledge and theory as if it were disposable property to be discarded in favor of the latest, most-fashionable concepts. Also, traditional providers of education (schools and universities) will need to place a premium on preparing students to learn. Emphasis will shift from the content of 'what' students learn, to the process of 'how' students learn. Professional certifications, evolving toward graduated competency-based models, will grow in volume and importance as organizations shift their expectations from knowledge and experience toward demonstrated capability and focused competence is developed dynamically in multiple disciplines as one's career unfolds.

6. Aging Population

The world's aging population provides both challenge and opportunity. Increasing life expectancies will challenge world resources and place increasing pressures on the cost of providing healthcare to a larger percentage of the world's population. Additional life expectancy comes at a premium in terms of healthcare costs and we have not addressed the ethical and moral issues for our belief in extending life "at all cost." Likewise, our models of social welfare are based on assumptions that those working will pay benefits for those not working. However, declining world population and an expanding number of aged people have invalidated this model and require new social systems.

While working longer is one option, if not a requirement for many, this postpones the day of reckoning and does not resolve the problem. Organizations will need talent, and people will need the economic means to shore up their finances. Retirement may actually become a short lived artifact, an ideal suitable only for the second half of the last century.

Opportunities also exist in this increasing "elder market." Never before has the world faced the numbers of aged citizens and little is known about the consumption and lifestyle needs of this segment. Demographers predict that by 2025 the majority of the population will be 65-plus. The majority! With the cost of housing, furnishings, and raising and educating children paid, we can anticipate changes in lifestyle options and experiences that are more suitable for this growing segment of the population while other segments are in decline. Quality of life may resurface in significance as it is not driven by the need for "more" and the engine of growth – rising populations – is no longer the driver. Stable or declining population will have a dramatic impact on the global economy.

7. 21st Century Quality

Quality itself has been identified as a force of change. Quality has been evolving over the past 25 years from a disjointed emphasis on a multitude of approaches into a more holistic systems approach that recognizes the value of multidiscipline and the appropriate

ness of its application across all sorts of enterprises. The practice of quality has travelled a path from quality through pride of workmanship, to quality by thorough inspection, to quality assurance of customer promises, quality by preventive action, setting targets for perfect quality, and most recently quality through innovation and design.

If quality in the last century was defined by control and improvement, it is clear – that while necessary – control and improvement will not be sufficient for the 21st century. Many predict that near perfect product/service quality will be a minimum for being competitive in the future. Table stakes. The best companies are moving beyond product quality to manage their total customer experience. Best practice companies around the world are showing, by their examples, the efficacy of quality applied to the improvement of the whole organization. Change and transformation are emerging tools of quality.

Throughout this evolution one truth has not changed: quality is ultimately what customers accept and what they value. This truth is shaping organizations, industries, and countries. This is an immutable truth: especially in an information rich environment. Organizations that absorb this fact into their culture and consciously act upon it will benefit from what quality is becoming. If they don't then they may become subjugated to those competitors that do recognize the transition and take affirmative action. Quality still provides a sustainable competitive advantage, wherever it's applied. It is also clear that modern quality practices are still less common than one might hope.

We have observed a transition of quality from a limited concept as an aspect of products and services, to the quality of management, and ultimately the quality of the enterprise itself. This evolution has been steady: the emphasis on quality has moved from products, to processes, to systems, to enterprises, and now we envision quality as a global force for the benefit of mankind as the greatest challenges lay outside organizational walls. So, quality will now contribute its concepts, techniques, and tools to address social problems. There is a huge opportunity for quality to increase its influence as a catalyst of change in the future and quality will continue to evolve in response to the long-term forces that will shape our future.

8. Innovation

Our world is affected by ever increasing rates of change in technology and this drives the design of products and services. It is natural that innovation moves to the forefront as a force for change. Innovation is a process of creating and implementing imaginative ideas that are useful. Innovations are not limited to new product research and development but may be developed in all aspects of the human experience. Innovations may be derived from existing works or conditions (supporting incremental improvement) as well as they may be independently conceived as in a radical breakthrough concept. It is clear that innovation is increasingly the lifeblood of all organization. With today's accelerating pace of change no organization can assure its future without an ability to deliver a continuous stream of valued innovations to its both current and evolving customer base.

Systematic innovation requires a purposeful, organized search for change that can make a

difference. This capability will be a differentiator between those organizations that act as successful entrepreneurs and those that stagnate in their ability to grow and develop. How to create an organizational culture that consistently innovates is a significant challenge of today's leaders. Innovation, along with related considerations for managing quality, risk, and return is poised to become a systemic focus area for education of the next generation.

Innovation implies the ability of a company to exploit technology and apply it in ways that anticipate customer needs, expressed or unexpressed, known or unknown, and then deliver products and services to the marketplace that excite customers. Innovating is then a driver in today's changing world, and will become even more so tomorrow.

Scenarios of the Future

The scenarios chosen for the ASQ Future Study provide a broad spectrum for challenging thinking about these possibilities for change from the perspective of each of the different forces for change. Scenarios represent a series of four potential circumstances that could be possible to evolve from our knowledge of the current state. These scenarios do not in any way represent a forecast of any future that will occur or even which is desirable. The use of scenarios in future studies is to use them as a means to think differently that we do in our routine, daily life. They cause us to consider what would happen as our world is in a process of migration from the current state to this future state. What are the potential hallmarks of change in the journeys represented by the scenarios? Learning opens our minds to new possibilities and opportunities that can shape the future in different ways. [21]

Long-term (20-50 year) effects that have an impact across all of the scenarios include:

- Shifting demographics in an expanding global population: as the population we will experience an aging in the demographic profile of most developed countries coupled with the development of a youth bubble in developing countries.
- Environmental impact: the impact of global warming off-set by the atmospheric cooling as the sun changes its radiation pattern

The question that must be addressed is not about whether these circumstances will occur or not, but about how their occurrence will impact world and how mankind decides to responds to these circumstances.

The structure of options for the long-term forces differentiates the four scenarios and respect to long-term forces provides a natural an understandable way to consider how the specific scenarios are described in the case studies that follow:

- *Scenario 1: Global Awakening – the Utopian Scenario*
  - Population: Stabilization in the range of 6-8 billion people

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[21] Peter Schwartz, *The Art of the Long View: Planning for the future in an uncertain world* (New York: Doubleday Currency, 1991).

- o   Environmental: Offsetting climate vs. long solar minimum
- o   Political: Enlightenment and coordinated global action
- *Scenario 2: Resource Restoration – the Preferred Scenario*
  - o   Population: Growth to replacement rate – 8-10 billion people
  - o   Environmental: off-setting climate vs. moderate solar minimum
  - o   Political: Collaboration among developed and developing nations
- *Scenario 3: Death by 1,000 Cuts – the Status Quo Scenario*
  - o   Population: Continued growth – over 10 billion people
  - o   Environmental: off-setting climate vs. short solar minimum
  - o   Political: Rigidity in political positions causes delay in corrective action
- *Scenario 4: Past the Tipping Point – the Doomsday Scenario*
  - o   Population: growth to 10 billion then rapid decline to less than 6 billion
  - o   Environmental: No solar salvation – global collapse of ecosystem
  - o   Political: Chaos and anarchy prevail

Scenario 1: Global Awakening

The people and nations of the world awakened to understand and anticipate the complex, multi-dimensional, systemic nature of the growing global crisis and have taken positive, enlightened technical and political actions, coordinated through the United Nations to assure equitable management of a sustainable world. Long-term technical solutions have been enacted to resolve difficulties with issues related to nuclear power (generation of clean, more efficient nuclear energy through fourth generation fast neutron reactors; storage, recycling and disposal of nuclear waste; and increased electrical system power efficiency and transmission loss management through universal smart grid technology); biotechnology (ability to understand and safely manage genetic modifications to improve crop yield and resistance to drought and pests); and nano-technology (delivering medical solutions that are able to target specific diseases and promote cardio-respiratory health). Solution of these ecological and energy management issues was possible during a 40-year period of solar pacification as a solar minimum offset the exponential heating effect due to the anthropogenic climate change and allowed mankind a reprieve from the climate deterioration. This wake-up call caused the people of the world to join forces and take seriously the cumulative impact of local pollution on the global environment. The UN precedent set in coordinating and balancing actions to reverse the ozone depletion crisis of the late 20th century was adopted to define requirements for economic development that will help assure improved quality of life for all mankind while managing the global environment so that is able to maintain the human race at a sustainable global population of 8 billion people. The appropriate use of technology has been employed to eliminate risk from potentially destructive failure modes of the environment and statistical analyses have been conducted to determine the actions that are most likely to reverse the effects of environmental pollution on the ecological systems of the world. Through global resource balancing the 'have' nations underwrite the 'have-not' nations in order to prevent them from taking actions that would reduce the ecological balance. Quality methods and techniques are built into local economies in order to plan win-win management of the global economic market place. The UN global economic council focuses on the well-being of the global community rather than just a community of individual nations, each

seeking its own advantage. In this environment technology is brought to bear against problems that most affect mankind as a whole, rather than merely for economic return (especially true for medicines and living infrastructure systems).

The forces identified during the ASQ 2011 Future Study have the following influence in this scenario:

1. *Global Responsibility*: Nations align themselves by regional divisions of nature (e.g., by dominant watershed rather than by geo-political or cultural boundaries in order to focus on how mankind can collaborate to assure that all people of all nations enjoy an equal opportunity to access the bounty of the Earth. The new economic currency is measured in terms of clean water, pure air, adequate foodstuffs and sufficient energy, rather than in monetary values which are empty when it comes to meeting the basic needs of human beings.
2. *Consumer Awareness*: Consumerism as a motivation for economic growth has been replaced by a new wave of austerity. Mankind has come to recognize that rampant consumption of resources is detrimental to a sustainable world. Waste can no longer be tolerated in the transformation of resources into useful products. The new standard for consumers to apply in decision-making is no longer driven by quality definitions for luxury, but for pragmatic utility in both the production and life cycle application of products to assure a minimal total cost to society for all necessary goods and services required to sustain an adequate quality of life for all consumers.
3. *Globalization*: By changing from a monetary policy for exchange of value to a social policy for exchange of value, mankind has shifted the global playing field. Indicators of social value are applicable across all nations and organizations in the world and are part of the fundamental human rights of each person: the right to exist, the right to socialize, and the right to personal development. Such rights are universal and global in nature. By emphasizing the similarities among nations and races, instead of a focus on the distinctions, mankind has developed capability to communicate across cultures and build rapport in the face of diversity rather than creating animosity and divisions that alienate rather than unite people. Finally, mankind has learned how to collaborate and 'come together' for its mutual benefit.
4. *Increasing Rate of Change*: Mankind has learned to harness change and accept the fact that just because change is possible, it does not mean that it is required as change that happens too fast and too often will lead to generation of waste. Competition, the true driver of change in the past, was replaced by cooperation as the motivators of society and social democracy replaced the capitalist motivation for all mankind to join the ranks of the bourgeoisie. Thus, introduction of technology has become managed across companies and transition from one technology to another minimizes waste and the potential for loss to society.
5. *Workforce of the Future*: The renovation of the world value system has fundamentally changed the definition of work. Work is any motion that produces value that benefits society. Thus, being a student is work; just as functioning as a family housekeeper of caretaker is work and performing physical or mental labor is work. Work has come to be thought of as a developmental process, rather than a series of actions that have been completed. Continuity in strategic direction and alignment of purpose are valued as

they eliminate waste and take advantage of past wisdom and lessons learned as a way to leverage future performance effectiveness and efficiency.

6. *Aging Population*: The aging population provides a resource of wisdom for society as older citizens remain active and forgo the "social benefit" of retirements in order to maintain exceptional healthcare. Maintaining the alert engagement of older minds is a facilitator of the required social transformation as the elder generations of mankind bear the responsibility for the effects that are being harvested in today's world and they have awakened to their obligation to correct past indiscretions and mistakes in order to make the world a better place.

7. *21ˢᵗ Century Quality*: Quality has become the pervasive value of the new society. It is both the objective of the social system (democratic quality of life) and a motivator for the use of resources (minimize the waste in resource losses to society). This has been called "the Taguchi effect" in honor of the Japanese engineer whose concept of value-based management created an economic foundation for the new non-monetary value system that has been introduced as a quality of life initiative by the United Nations. In the traditional sense of quality sciences, the philosophy, methods, and tools of quality have been incorporated into all engineering disciplines and all professional societies and associations have a division or special interest group that focuses on the adaptation of quality into their discipline and body of knowledge. Quality is truly ubiquitous – it is found in all professions, government, education, healthcare, as well as commercial organizations. No matter what questions are raised in society, quality contributes to its answer and provides the direction for decision-making and making rational choices in an uncertain world.

8. *Innovation*: An evolution toward inclusive innovation is a hallmark of transition to the future generations of mankind. Based on growing social awareness, mankind learned to appreciate the opportunity that human diversity has to expand the potential universe of possibilities for useful ways to develop and apply technology so that Earth's limited resources are valued and their consumption is not squandered in wasteful acts, but is invested in lasting value that is produced for mankind. This realization has separated the general concept of innovation into macro-innovation and micro-innovation. When useful ideas are developed for new technologies, new products or new services, these represent micro-innovation or innovations that may, or may not, support the need for global sustainable development and must be tested to assure that waste is not built into this "innovative development." Macro-innovation focuses on the global environment and it focuses on understanding and improving inter-system operability so that total waste is minimized across all global resources. Innovation has moved from an art to a science that contributes to the policy decisions that govern global activities.

Scenario 2: Resource Restoration

Nature has granted mankind a reprieve from the effects of global warming through a solar pacification which lowered the average earth temperature 7°C and more than offset the accumulated impact of a 40 year thermal rise. While the contribution to global warming from environmental pollution continues to rise, the net effect on the climate is being masked by the decrease in solar radiation has a cooling strong on the Earth caused by the decreased activity level in sunspot eruptions. Thus, these cooler temperatures roll back

the negative effects of climate change by relieving the symptoms of anthropogenic global warming, but this effect does not address root causes. However, creation of this mini-Ice Age has had a beneficial effect as it has stimulated the leaders of all governments to face the reality of the fragile environment and to take a more conscientious approach to the systemic solution of the driving causes. One of the driving causes of climate change is the growing population. Global leaders have agreed to use a combination of tax policy and contraception to manage population in the range of 8-10 billion inhabitants and to work on improving infrastructure to support this population with pure water and adequate food. Emphasis will be on raising quality of life for all people and providing meaningful and honorable work that supports a global ecosystem that is sustainable. Universal education is encouraged to increase global literacy and improve the participation of people in local and national politics. Business awareness increases as organizations begin to realize how dependent they are on a steady supply of affordable energy, clean air and pure water to manufacture product and deliver business services. Technology is discovering ways to extend the projected life of known resource reserves by creating more efficient applications – as it has in nuclear power industry while the old 60-year estimate for our uranium reserves has been extended to over 3,000 years of energy supply (without any new discovery of sources for uranium). The world is coordinating and dedicating its shared resources to correct all of the deficiencies of past generations and assure the survival of mankind on the planet.

The forces identified during the ASQ 2011 Future Study have the following influence in this scenario:

1. *Global Responsibility*: A strong regionally-based geopolitical alignment has occurred in all areas of the world with the leading developed nations taking responsibility for oversight of the less-developed nations, following the examples established by the European Union and the Organization of American States, and coordinating their regional actions through the United Nations. While a "global democracy" may be the ultimate objective for mankind, lessons learned in the "Arab springtime of democracy" indicate that regions of the world are more likely to be influenced by polices that affect their neighbors rather than more remotely influence the entire world.
2. *Consumer Awareness*: In general, consumers have become aware that their buying criteria must include not only performance and quality, but also environmental impact of the goods purchased. Consumers flock to the Internet to search out and understand the environmental impact of their personal purchases of "durable goods" and use this information to shape their personal buying trends. Business-to-Business procurement follows the lead of these individual consumers in enacting a "Go Green" campaign to increase their sensitivity to the environmental impact of their entire supply chain.
3. *Globalization*: Mankind has come to grips with the global systems and understands the interconnectedness of national, regional and global infrastructure. Commitments are made to work together across boundaries to address and resolve regional and global problems and the typical political posturing for leadership and "equal rights" among nations with respect to decision-making processes was resolved through a regionalized division of the UN to create spheres of influence for all major geo-political areas (e.g., Brazil takes the role of influence-shaper for South America, as does China for Eastern

Asia, India for the Middle-East, Russia for Central Asia, while the EU and America continue in their traditional roles. The African Union increases its political strength and establishes a close mutually beneficial relationship with the League of Arab States. Nations are now pooling their resources and "out-sourcing" governmental activities that are capable of consolidation through the use of "cloud computing" services to reduce the cost of local investment in information technology infrastructure and the human capital investments required to manage the common services of governments.

4. *Increasing Rate of Change*: The need to manage some forms of change have become apparent to global leaders and the initial actions in managing change have come by a legal process of license requirements for technology implementation. Control of new product change moved from patent law for protection of intellectual property to the use of law for control of new technology introduction through a process for granting licenses to produce using new technology. This licensing process applies only to the technologies that require consumption of natural resources for production of durable goods. Standardization of computer systems has come into effect through the cloud computing capability so that software improvements use more natural migration paths and cause less end-user anxiety as they change. Human systems also seek a base level of stability so that people can come to rely on systems and processes to deliver what they have come to expect as outcomes and when changes occur they have been fully tested and approved by users, rather than foisted upon mankind by producers. Power in production management has shifted toward customers.

5. *Workforce of the Future*: The need for literacy has been extended from the basic need to educate in reading, writing and arithmetic to include an advanced level for global citizens that extends core basic education to include systems, statistics and quality. In order to become either a "certified production worker" or "certified service provider" workers must complete education programs in all of these core job competences and pass a basic test in their native language to demonstrate entry-level proficiency in both the theory and application of these concepts. Developmental pathways for workers of the future are less functionally-constrained and are individually planned to provide for a transition in personal growth from the apprentice level to the craftsman level in all of the recognized work disciplines and vocations. Performance at each higher skill level leads to a program of both economic and esteem (recognition) benefits for workers.

6. *Aging Population*: Senior citizens are transitioned into elder statesmen and mentors to youth as a means to leverage their knowledge and experience and funnel their mental energy toward resolution of the problems that were created by their generation so that future generations are not caught in the same "me-first" trap of runaway consumption leading to squandered global resources and waste of the global society's opportunity to turnaround the environmental, political and economic crises that drove civilization to the brink of collapse. The elders are teaching mankind the benefits of austerity and the stewardship of natural resources which is based on the fundamental principles of all organized religions in the world and causing people to examine more carefully "what unites us" rather than myopically focusing on "what divides us."

7. *21st Century Quality*: The disciplines and movements of quality have merged to form a more coherent approach to quality that combines business excellence, lean production, standards and conformity, and Six Sigma communities in a global quality community focused on applying all the quality sciences and practices toward a common goal that

is for the benefit of mankind – improving the global quality of life. Centers of quality competence (e.g., reliability, statistics, auditing, etc.) support communities of practice (e.g., healthcare, education, government, industry, service, etc.) and coordinate the use of best practices across organizational and national boundaries.

8. *Innovation*: Technology firms have set a new standard for cross-company cooperation through "collaborative engineering" of new technologies. Unlike joint venture types of innovation incubators, collaborative engineering consortia pool their technological prowess and intellectual property for the benefit of entire industries. Governments recognize the value of such resource efficiency and reward participating corporations with significant tax incentives which are only available upon completion of projects to the point of approval by cross-industry consumer panels. Cooperation across industry replaces the model for innovation driven within companies as the imperative for the development of environmentally friendly technical solutions forces mankind into a war-time response requirement for focused technical breakthroughs. Continuous and systematic innovation becomes a requirement and research and engineering must focus on innovating on demand to resolve focused problems effectively, efficiently, as well as economically.

Scenario 3: Death by 1,000 Cuts

Petty bickering among liberal and conservative political parties in world governments has significantly delayed development of a global, collaborative approach to the pressing, population-driven, anthropogenic changes in climate. Arguments over the meaning of the symptoms and the sources of chemical pollutants as well as key interrelationships among these various factors caused a breakdown in political will for change as politicians continuously questioned the scientific methods as well as interpretation of observed data. Finally, the reality of solar pacification struck home after four years of rapidly decreasing temperatures coupled with negligible sunspot activity to convince politicians that action was imperative. However, delays from addressing the need for change and convincing all constituents that they must be active in the change resulted in growth of the global population beyond the level of sustainment to 10 billion inhabitants, after which time the population stabilized to the rate of replacement. However, global drought from climate change exacerbated the short food supply and famine became wide-spread among both developed and developing countries as food distribution systems were no longer able to support these dense population centers in megacities or the wide population spread in rural areas. Riots erupted into mob violence in megacities as criminal gangs take over distribution of the new drugs of choice – milk, bread and eggs. Governments call for the military to manage food distribution across the 600 global megacities as citizens migrate to the countryside in desperate search of food and water. Developing countries with agrarian economies increase their value as global partners as the former economic leaders scramble to provide their citizens with basic needs. Rigidly polarized political positions have also caused delays in making decisions for implementing technical solutions so the world is behind the power curve for corrective actions and it appears that the ecological imbalance in nature may require a century or more for its restoration. The repairs are underway but humanity will suffer throughout this long recovery period. Out of panic, nations took many parallel actions for improvement; however, they did not use systemic

tools of quality to continuously improve their environmental operations. As final analysis of the human response, it has been a case of too little, too late, without the proper focus, thus mankind suffered from an accumulation of a multitude of poor decisions that it made in the past and will pay the long-term penalty for these oversights because it will require several generations for complete recovery.

The forces identified during the ASQ 2011 Future Study have the following influence in this scenario:

1. *Global Responsibility*: Mankind has been globally irresponsible for many decades and it is difficult to overcome the lackadaisical inertia that has become ingrained into the popular culture of the world. In order to reverse the historical trend shock therapy is needed so that popular opinion can be focused on addressing issues of unpopular choice. The net effect is a renaissance of positive global socialism that cuts across religious, racial and cultural barriers and focuses on the developing security in livelihood for all of mankind. The movement to "global goodness" came at a high price as the delay resulted in increased pollution and enhanced the negative effects of climate change.

2. *Consumer Awareness*: Consumers are perhaps now more aware than ever, even if their criteria for choice have been greatly marginalized to seek dependability of core functions at the best price point as the emerging definition of "exciting quality" in products. The market of today is less willing to suffer the price contributions of poor design processes or waste in production or materials and is seeking greater assurance that products will last for their advertised lifetime. Reliability, rather than overly aggressive marketing promises, will drive the future market place.

3. *Globalization*: Globalization is contracting from its original focus to become more of a regionally-based collaborative based on negotiated positions among national members. In their inability to build a "global cohort" nations initially focused on increasing their own standard of living by focusing on consumer-based development. As the crisis unfolded, this self-centered approach collapsed as global supply-chains disintegrated and business based on such arrangements transitioned to crisis-mode operations with a hugely negative effect on both national and global economies. As enlightenment dawns, people realize that what affects any of us adversely, affects all of us adversely. Global economics cannot be played as a zero-sum game with winners and losers – dividing the world into both have and have not classes. True democracy requires equitable global distribution of wealth that is sufficient to assure equitable quality of life for all people. Thus, a new basis for economics is born on a global scale – capitalist Marxism: blending of both traditions into a holistic economic system for the good of all people.

4. *Increasing Rate of Change*: Change has no longer been either linear or exponential; it can only be characterized as randomly radical as the climatological systems that support life on the Earth reel through major cycles of change. These changes have driven all of the man-made processes and economic forces into reactive modes and global decision makers have made judgments based on selective perceptions which further randomized the world system's responsiveness. In short, the world has become a mess and changes from minute-to-minute as each constituency jockeys for a better position to assure that they obtain their fair share of the limited resources available for distribution. Change in this scenario was becoming synonymous with chaos – up to the point of enlightenment.

As world leaders recognized that they must modify many global behaviors in order to repair the Earth's natural, economic and social infrastructure, a new emphasis on daily management systems with its application of control theory have replaced the focus on evolutionary and revolutionary change with a global desire for stability and control.

5. *Workforce of the Future*: As the changes occurred in this scenario, leaders also came to realize that new skills were required for the future: managers must comprehend how to manage risk and achieve control while workers need to become more proficient in the use of data measurement and monitoring analysis to support daily management systems. For all literacy in process management and statistical thinking fundamentals are a core learning requirement. Working in multi-disciplinary teams on cross-functional tasks will also require greater interpersonal skills as well as a strong appreciation for the value of diversity in achieving consensus solutions across such non-homogenous groups.

6. *Aging Population*: Through the strife that existed in the stressful turnaround, the world lost a generation of senior citizens and their collective wisdom vanished with them. This prematurely missing generation was caused by the global famine and related epidemics which affected the both aged and infant populations who are more vulnerable to health risks than the relatively more healthy middle-aged population. In effect, environmental euthanasia corrected the imbalanced caused by the aging population factor.

7. *21ˢᵗ Century Quality*: The quality has been restricted to micro-economics applications within a firm, rather than employed as tools and methods that are suitable for the benefit of the social system. Quality sciences are enshrined into the new product development process as they provide assurance of product reliability. Emotive politics overcame the rational decision processes promoted through total quality management and required that an independent mediator board of "wise men" validate the science upon which are made the critical decisions for environmental resurrection. Quality professionals on a global level rise to serve in this neutral and objective capacity and have an essential role in the forging of a turnaround.

8. *Innovation*: Innovation, or the development of useful capability, has not been allowed to operate as resistance to change has effectively blocked these new ideas as company managers require significant forecasted return-on-investment for every new product and many of the innovations needed for society have longer payback periods than desired as they create new infrastructure to recover from the past environmental degradation. As government and business leaders considered the financial implications as dominant in their decision-making, few environmental innovations passed the development threshold. In the name of maintaining sound financial value, many new environmental technologies never saw the light of the marketplace. In the end financial considerations trumped the technological innovations.

Scenario 4: Past the Tipping Point

The ecological systems of the world have suffered a cataclysmic collapse at the hands of man-generated pollution. The ozone layer, once saved from chlorine, becomes victim to methane and unchecked increases in the density of carbon dioxide and nitrous oxide have served to accelerate the warming effects of the other greenhouse gases. The brief respite from solar pacification merely served as an excuse to allow naysayers to delay addressing the problem as they held that this was evidence that global warming was not significant;

however, as the period of solar pacification ended in less than a decade, the readjustment of thermal shift was too fast, and too much for the scientists to thwart, so Earth suffered a global melt-down of the polar ice caps as well as all major mountain glaciers, raising the ocean surface approximately one meter and thus adding even more pollutants. The resulting acidification of the oceans caused the loss of major fisheries around the world and coral reefs have died while coastal residents fled to find new temporary homes on higher ground. While population had grown to 10 billion inhabitants, it rapidly fell to less than 6 billion as the lack of speedy and effective human response to the challenges of climate change created global chaos through war, plagues, famine, and pandemics. The future does not look bright as mankind has taken a quick, giant step backwards toward the Stone Age and Earth's biodiversity has been reduced to a fraction of the pre-pollution era. Mankind's ability to recover remains uncertain as the strong survivor instincts of the individual nation states inhibit the global cooperation necessary to reverse this disaster.

The forces identified during the ASQ 2011 Future Study have the following influence in this scenario:

1. *Global Responsibility*: Mankind acted irresponsibly with respect to the environment and has sown the seeds of its lack of timey action. Fractious behavior and the selfish pursuit of conspicuous material consumption characterized the economic behavior that motivated global behavior to blindly pursue consumption of the Earth's resources in a never-ending desire for more and better durable goods and possessions, rather than working in an austere way to achieve an adequate quality of life for all. The principles of social democracy were generally rejected as nations acted in insular ways and they assumed isolationist attitudes toward multi-cultural and restricted their cross-national cooperation. Only when the environmental situation became widely recognized as "in extremis" did any global cooperation become possible and even then cooperation was laced with mistrust as developing nations remained skeptical regarding the motives of developed nations.

2. *Consumer Awareness*: consumers continued to pursue more, better, faster functionality in products and valued luxury brands highly until the global collapse occurred. After the collapse, consumer backlash rapidly occurred against luxury brands that did not offer reliability as a fundamental feature and caused many brands to lose value and to disappear overnight. Post-collapse the economy contracted greatly and consumption focused only upon essentials of life to assure existence of individual family units. As the economy also collapsed, those people who occupied white collar vocations had a disproportionate suffering as they did not have anything perceived as valuable to trade in the barter-driven markets.

3. *Globalization*: The collapse of the ecological systems initiated a sequence of falling dominos as social, economic, and political systems all rapidly gyrated out of control and collapsed. Populations in megacities were especially hit as their infrastructure so strongly depended on external system support and since the megacities were also hubs for global commerce and locations where international commerce and global dialog occurred, now they have become war zones as people fight to survive. Globalization and cooperation have ceased and the megacities have become totally dysfunctional

4. *Increasing Rate of Change*: Upon global collapse, the increasing rate of change finally first stagnated and then reversed into a constantly declining state of degradation. Work on preserving the basics of society was required as in reconstruction of a war-torn country: energy systems for power; clean water for human consumption; foodstuff to assure adequate nutrition; shelter capable to protect families from increasingly harsh weather; and transportation to permit movement of goods between communities that became isolated as increasing sea levels caused havoc among shipping systems.

5. *Workforce of the Future*: Skills that were once highly valued have no value in the new "survival-based" economy. Mankind has reverted back and now values skills such as foraging, hunting, fishing and camping and those who survive are people who can most readily adapt and learn to live off the land without the support and conveniences that were once offered as an accepted convenience in modern lifestyles.

6. *Aging Population*: Aging population is no longer a problem as the global warming had the greatest impact on the elderly and the young as their survival rates were bleak in the face of the climate change. So drastic has been the impact of climate change on life that all of humanity is now operating on a survival of the fittest basis, scavenging for the means to exist for another day.

7. *21ˢᵗ Century Quality*: The new quality is the old quality: assuring basics necessary for quality of life and attempting to climb Maslow's hierarchy to maintain homeostasis at the existence level. Emphasis on quality is merely placed on achieving subsistence products and transferring survival knowledge from generation to generation.

8. *Innovation*: Following social systems collapse the emphasis on innovation shifted from structural innovation within organizations to reinventing local innovations that are essential, both necessary and sufficient, and assure the basic qualities of life. In this scenario, innovation, as previously defined, becomes passé as the value system that supported it has died.

Leadership through Quality is Required to Improve the Future

We must remember that prognosticating does not assure that we will ever possess the "correct" view coming events. This is true for two reasons: first, the data does not lend itself to full knowledge; and second, what knowledge we can gain is at best a probability with a high degree of uncertainty attached because the relationships among the factors are a complex "mess" representing a truly "wicked problem"[22] that will require intense cross-disciplinary collaboration to solve. Or as Russ Ackoff so aptly phrased it: "so much time is currently spent in worrying about the future that the present is allowed to go to hell." [23] The choice of an action path should be built on facts and data, following a classic approach to quality: learning about the process, observing facts, analyzing data and making estimates about performance. This has been the historical strength of quality analytics. However, performance measurement is both a science and an art and such observational knowledge can only take us so far in the face of a wicked problem. Let's consider our predicament from both a data perspective and as it merits assessment as a

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[22] Horst Rittel and Melvin Webber; "Dilemmas in a General Theory of Planning," **Policy Sciences**, 1973, Vol. 4, Amsterdam: Elsevier Scientific Publishing Company, Inc., pp 155-169.
[23] Russell L. Ackoff, "Thinking about the Future and Globalization," **Proceedings of the 25ᵗʰ Annual Tallberg Forum**, 2006.

complex systems problem.

In his book *The Functions of the Executive*, Chester I. Barnard described a hierarchy of data types in terms of the certainty of knowledge that is produced.[24] This hierarchy of data types and the nature of knowledge derivable from this data are indexed from most tangible to least tangible in terms of certainty. At the top of this scale reflecting the most certain of our observations are physical data, biological data, and process data. At the mid-range in the certainty estimates are economic data which represent approximations using probability estimates. At the low end of the scale are the intangible data categories: political, social and moral data. Interestingly, the environmental data that we observe is the most tangible of information used in a futuring study. Economic outcomes from the study of such data are mid-scale on concreteness and have a high degree of uncertainty. But the least tangible data comes from the political, social and moral sources which are all drivers of the decision-making process that allows a consensual judgment to be drawn and agreed from the tangible data in order to affect economic development outcomes. In other words, science can lead us to consideration of outcomes for society which possesses economic ramifications that are uncertain at best; however, the most uncertainty in the decision-making process originates in the multitude of political, social, and moral issues that are generated by the plurality of the human race. Thus, the problem is exacerbated by the distinction in the way that nature works and the way that people think.

But we also face a "wicked problem." What does this mean?   'Wicked problems' are complex and have some social or economic interactions that inhibit it from becoming fully solved. This type of problem is systemic – there is no easy, direct answer that resolves the issue. Another concern about a 'wicked problem' is that we tend to harbor a lagging belief that there is somebody who knows its answer. Perhaps, we just haven't defined this problem well enough ourselves to understand it fully, but we believe that: surely, there is an expert somewhere working on it who has characterized it completely? And, finally a 'wicked problem' is one that is entangling – it has influences that interact with other events or situations to drive change in unanticipated directions – we become victims of 'unintended consequences' because we don't fully understand the ramifications of the decisions that have been made beyond the narrow boundary experience of our limited experience or knowledge.   In other words we have so decomposed the problem in order to understand it that the eventual systemic effects are unknown and unobservable – they have become invisible from our perspective. All of the problems defined in the future scenarios are wicked problems.

Who is to blame? It is the functioning of chemical and biological systems and the design of human systems that are at the root of today's problems and these factors have become exacerbated by the motivation of people who desire to improve their quality of life. Our problems are influenced by numerous factors: population increases and urban sprawl, rapid acceptance of technological advances, the relative disparity in economic well-being ranging from exceptional affluence to extreme poverty, and the nature of humanity with its conflicting desires altruism and self-interest driven by greed and fanned by the fires of human ignorance. Our wicked problem is driven by all of these factors, so the problem is

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[24] Chester I. Barnard, *The Functions of the Executive* (Boston: Harvard, 1936).

really no body's fault – however, it is the obligation of mankind to solve it. But solutions to such problems are rarely simple. Economist Henry L. Menken is quoted as saying that "for every complex problem there is a simple solution, and it is wrong." We must not become bogged down in playing the "root blame analysis" game. It is time for mankind to focus our best efforts at solving these problems that threaten our very existence.

The response that mankind takes to the challenges of the future must have at least three components: it must be a universal approach to a global problem and involve all of the governments of the world; it must combine our best scientific knowledge and theory with an ongoing effort to investigate and control the causes of problems, not just controlling their effects; and the actions that we take must be coordinated globally to assure a truly universal response. And this implies that the United Nations must play a pivotal role, just as it did in addressing the 1980s problem of the ozone hole. Two themes of the UN's global agenda are pertinent in the pursuit of these issues: good governance and global sustainability. What do these two themes mean?

The United Nations defines good governance using eight characteristics: participatory, consensus-oriented, accountable, transparent, responsive, effective and efficient, equitable and inclusive and follows the rule of law. Such a system will minimize waste, abuse and corruption; as well as take into account the concerns and rights of minorities and society's most vulnerable members in the decision-making.[25] The emphasis on waste reduction coupled with effectiveness and efficiency are an open invitation for quality to become a critical enabler of the required global transformation. Good governance is necessary to effectively and efficiently coordinate human action to address our common problems.

Sustainability, the second applicable UN agenda item, is the capacity to endure and it involves coordinating global actions relating to the bottom half of Barnard's data scale where personal opinions, expert assertions, and political positions, are typically accepted as facts: the world of economic, political, social, cultural and moral considerations. The sustainable development of the world refers to "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." It balances global aspirations for a better tomorrow with the need to carefully manage and preserve the life support systems of our planet. However, the fundamental concept of the meaning of sustainable development must be clarified. Russ Ackoff emphasized this point in his Tallberg Lecture: "I see little evidence that international programs currently directed at producing development know what development is. *Development is not the acquisition of wealth,* an increase in the standard of living, as they assume. *Standard of living* is an index of growth, not development. *Quality of life* is an index of development. Development and growth are not the same thing." Thus, to understand what is meant by sustainable development, we must come to grips with the meaning of quality and define it for the coming age, much as Robert Pirsig approached this problem in his classic novel ***Zen and the Art of Motorcycle Maintenance*** in 1974.

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[25] http://www.unescap.org/pdd/prs/ProjectActivities/Ongoing/gg/governance.asp.

In the face of these threats, mankind must focus on how to alleviate the problems through coordinated human action: healthcare, agriculture, engineering, etc. What is the role that quality plays in these fields of human endeavor? We must remain open to discovery of the unknown and explanations for the currently inexplicable. Science is the unraveling of life's mysteries and quality has a definite role in science as it provides an explanation for the motivation of scientific discovery: improvement of the quality of life for humanity. Nothing less is suitable for the profession.

If we think differently, using a systems approach, then maybe we can act more decisively and work to remove ourselves from the mess that we find ourselves in today because in the past we have used only yesterday's thinking methods and tools to try to solve today's wicked systems problem. However, we must permit science to inform and instruct those who create policy and we must use the best of our thinking processes to develop a course of action, rather than permit the future of our world to be determined and driven by base politics.

This takes ASQ to the next phase of its future investigations: what should be done in a different way and how should the global quality community respond to the implications implicit in these scenarios?

For those interested in additional reading:

1. Thomas L. Friedman, *The World is Flat: A Brief History of the twenty-first century*, Release 2.0 (New York: Farrar, Straus and Giroux, 2006).
2. Thomas L. Friedman, *Hot, Flat, and Crowded: Why we need a green revolution and how it can renew America* (New York: Farrar, Straus and Giroux, 2008).
3. Alan Greenspan, *The Age of Turbulence: Adventures in a New World* (New York: Penguin Books, 2007).
4. Nassim Nicholas Taleb, *The Black Swan: The Impact of the Highly Improbable* (New York: Penguin Books, 2007).