The Center for
Nanotechnology in Society
ARIZONA STATE UNIVERSITY

CNS Visioning Workshop Report

CNS Visioning Workshop:

Creating Scenarios about the Future of

Anticipatory Governance

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NSF

PREFACE:

This report presents the findings of the Center for Nanotechnology in Society Visioning Workshop held on October 11-12, 2008 at Arizona State University.

This report flows from the discussions held during the workshop, roughly following the agenda. The agenda was designed such that each discussion built on what came before, so that emergent ideas formed the basis for future exploration. The contents of the report are thus:

- ❖ Anticipatory Governance: A Social Technology
- ❖ Building Reflexive Awareness
- ❖ Natural Science Collaborators
- ❖ History of Real Time Technology Assessment
- ❖ Key Drivers of Change Related To Anticipatory Governance
- ❖ Predetermined Elements
- ❖ The Scenarios
    - * Innovators of the Apocalypse
    - * The Dalai Lamas Hotdog
    - * The Grid
    - * EcoWorld
- ❖ History of The Future
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- ❖ CNS Visioning Workshop Participants

ANTICIPATORY GOVERNANCE: A SOCIAL TECHNOLOGY

Building scenarios is a way to extend and challenge perceptions and embedded assumptions. Engaging expectations is a means to become aware of probable, desirable, repulsive and possible futures and take responsibility for futures put in motion. Futures in the making manifest every day, with every decision, yet are poignantly evident in early stage technologies, including social technologies. Developing sensitivity for the array of plausible futures through studied deliberation prepares the way for responsible and robust decision making in the present.

In October of 2008, a group of interdisciplinary researchers involved with the Center for Nanotechnology in Society (CNS-ASU) participated in a scenario building exercise. The CNS Visioning Workshop took the tools of Real Time Technology Assessment (Guston and Sarewitz 2002) as a social technology and explored what the future of governing new technologies would look like in 2025. Using the "intuitive logics" approach to scenario development (Wack 1984), the group created through sustained inquiry an appreciation of the potentials and challenges attending anticipatory governance.

The purpose of the workshop was to:
- Identify the variables that condition the effectiveness of anticipatory governance- now and in the future;
- Explore how the varied human and social systems that embed real time technology assessment might change over time and with what consequences;
- Find alternative ways of thinking about how social science knowledge can improve the effectiveness of human action;
- Determine which designs and decisions bring about "ideal" anticipatory governance.

Anticipatory Governance refers to the broad based capacity to "collectively imagine, critique, and thereby shape the issues presented by emerging technologies" (Barben et al 2008, p. 992). As practiced at the CNS, anticipatory governance relies on a three-tiered platform of anticipation, integration and engagement. Anticipation refers to thinking in advance about societal values and institutional change so as to leverage the relative openness of technological systems before lock-in of markets, values and trajectories set in. Engagement activities capture the need to broaden deliberation and participation around emerging technologies in such a way to capture societal values. Integration refers to building into the scientific enterprise attention to the broader social context. Guston (2008) explains, integration: "increases the capacity of natural scientists to understand the societal aspects of their own work, be more reflective about practices and choices within the laboratory and if necessary change their practices to align their research with public visions and values" (p. 940).

RTTA stands as one confirmation of methods that lead to a broader capacity for anticipatory governance. Guston & Sarewitz (2002) characterize RTTA as: "Integrating social science and policy research with natural science and engineering investigations from the outset…[to] inform and support natural science and engineering research, and…provide an explicit mechanism for observing, critiquing, and influencing social values as they become embedded in innovations" (p. 93).

Our task for the workshop was to imagine anticipatory governance as a social technology and conduct a foresight exercise that asked: What is the future of anticipatory governance in 2025?

The timeframe was meant to situate our discussions beyond the intellectual and strategic challenges of the present and to question how the forces underpinning the success and failure of anticipatory governance may change over time. We were also challenged to think of RTTA beyond how it is put into practice by the Center for Nanotechnology in Society and question how it may arise in other contexts with different actors.

Our key research questions were: What are the alternative pathways for the development of anticipatory governances? How might anticipatory governance play a constructive role in mediating the relationship between technology and society?

The outcomes were aimed to:
  - Develop a collective understanding of the key uncertainties confronting anticipatory governance
  - Enhance our capability to make meaning from the signals in our environment
  - Begin to develop strategies for advancing real time technology assessment

BUILDING REFLEXIVE AWARENESS

The visioning workshop thus was a serious effort to put anticipatory governance under the microscope and turn our tools on ourselves.

Reflexivity is an important component for Real Time Technology Assessment as well as a crucial process underpinning the work of the CNS. CNS's founding project proposal states: "CNS-ASU will probe the hypothesis (Lindblom, 1990) that a greater capacity for reflexiveness – that is, social learning that expands the range of available choices – in knowledge-producing institutions can help guide trajectories of knowledge and innovation toward socially desirable outcomes, and away from undesirable ones" (CNS project description). Erik Fisher, Assistant Research Professor at the Center for Nanotechnology in Society, produced the following provocation to lead the discussion on reflexivity:

Oxford English Dictionary:

reflexiveness. The state or quality of being reflexive.

1667 H. MORE *Div. Dial.* I. II. 234 There not being that Reflexiveness…in Brutes in their suffering as in rational Creatures.

So **refle·xivity**.

1977 DOUGLAS & JOHNSON *Existential Sociol.* v. 172 Reflexivity refers to the mutual interdependence of observer or knower to what is seen or known.

**reflexive, *a.* and *n.* *Social Sci.* Applied to that which turns back upon, or takes account of, itself or a person's self, esp. methods that take into consideration the effect of the personality or presence of the researcher on the investigation.

1977 R. HOLLAND *Self & Social Context* v. 82 In both cases the person producing the theory is included within the subject matter he attempts to understand. The usual term for this kind of approach is 'reflexive', a word which has begun to appear in the human sciences...but which has long been implicit in social theory.

<u>Lynch</u>: Ethnomethodological reflexivity…alludes to embodied practices through which persons singly and together, retrospectively and prospectively, produce *account-able* states of affairs. [As such it is] ubiquitous and unremarkable (2000, 47).

<u>Guston & Sarewitz</u>: [RTTA seeks] to build into the R&D enterprise itself a reflexive capacity that encourages more effective communication among potential stakeholders, elicits more knowledge of evolving stakeholder capabilities, preferences and values, and allows modulation of innovation paths and outcomes in response to ongoing analysis and discourse (2002, 100).

<u>Fisher, Mahajan & Mitcham</u>: A key to [such] capacity building is for actors to become attentive to the nested processes, structures, interactions, and interdependencies, both immediate and more removed, within which they operate. Such attentiveness leads to what is termed here "reflexive awareness" (2006, 492).

Accordingly, a three-stage modulation framework (Fisher & Mahajan 2006):

1. *De facto* modulation: Reflexivity in practices occurs as a matter of course;

2. *Reflexive* modulation: Actors become aware of their role in *de facto* modulation;

3. *Directed* modulation: Actors alter their behavior in light of their own normative commitments and reflexive awareness.

NATURAL SCIENCE COLLABORATORS

Our natural science collaborators were invited to speak about their experiences with and hope for real time technology assessment. Their comments are summarized here.

Dr. Neal Woodbury is a Professor in the Department of Chemistry & Biochemistry in the College of Liberal Arts and Sciences, the Director of the Center for Biooptical Nanotechnology and the Deputy Director of the Biodesign Institute. He leads a team that seeks to develop molecular devices and nanoscale hybrid electronics for use in biomedicine, environmental remediation and monitoring, threat detection and agriculture. Dr. Woodbury is an advocate of interdisciplinary science as a means of providing researchers greater vision in addressing real-world problems. Dr. Woodbury received his B.S. in Biochemistry from the University of California at Davis and his Ph.D. from the University of Washington.

Dr. Neal Woodbury explained that while his main motivation for doing science is that it is fun, he noticed in the course of his career that he had "no way of evaluating if what I do has any benefit to society." While he may try to create progress and "do good" for society, he didn't really know what such responsibility looked like. "If I knew what was beneficial, I would be able to do better in my efforts to push theories forward. "Instead of being limiting, [working with CNS] has given me more opportunities to make more persuasive arguments." This is not about being a good guy, but rather [integrating social science with natural science] is "good for research and creates opportunities." We must question "who's making the decision about what aspect of a technology is good for the world?"

It is important for scientists to "find out that what you do is either not good for people, or is unacceptable for them". It is important to consider how "science is good for the world, but also to ask, who is making decisions of how good it is for the world?"

The big question is how to implement these social concerns in the development of science. "Better integration will make it more successful, with better outcomes and better benefits." Yet implementation will be difficult. "The wheels are not turned in that direction yet." One example is the Tubes in the Desert program. There you find a "cultural divide" and a problem of resources. The question is really how to implement on a major scale, beyond the NSF broader impacts statement.

One barrier to implementing collaborative efforts between natural scientists and social scientists has to do with the priorities of the students. Students need to focus on their research in order to complete their degrees. "It needs to be made clearer to faculty that [working with RTTA] is not a matter of giving up something to help the world, but that if you work with the right people, such collaborations will actually make your life easier and you will get access to more resources." "Advisors are worried about students who may be overly concerned with social implications. Faculty need to understand interaction can make students better scientists." The point needs to be made that working with CNS is not being a part of a "charity" where the scientists "given up something", but that "if you did [science] smartly, you will go forward and life will be easier."

Dr. Stuart Lindsay is a Professor with a joint appointment in the College of Liberal Arts and Science departments of Physics; and Chemistry and Biochemistry and is the Director of the Center for Single Molecule Biophysics at the Biodesign Institute. He specializes in biophysics at the molecular level and scanning probe microscopy. Much of his work is aimed at speedier diagnosis as well as to medical breakthroughs to understand and cure many diseases. Dr. Lindsay's lab conducts innovative research in biological physics, molecular electronics, solar energy and condensed matter physics. He holds a PhD in Physics from the University of Manchester.

Dr. Stuart Lindsay took issue with the terminology RTTA because it suggests a "good cop/bad cop" dynamic with the social scientists policing the natural scientists. However, he has seen that his and his students' interactions with CNS have been beneficial.

Dr. Lindsay evoked Einstein to say that "research is when I don't know what I am doing" and relates scientific discovery to a spiritual process that he is in awe of. "Science is my religion" and a "powerful and moving experience." It is a "fascinating combination of throwing oneself into the unknown" yet with a "prepared mind".

"The translation to market does not occur spontaneously" and so the prepared mind should include attention to social and economic implications. "How can we put talented teams to work on societal issues?" To bring in those from the business school and really expand on the idea of interdisciplinary? We should redirect efforts across campus to focus on "big projects" and take the "brakes off" interdisciplinary evaluation. He argued for the elimination of all departmental and disciplinary boundaries and a reorganization of effort around important problems. "It is a concerted team effort to solve social problems." We need to focus on the transference of skills, nurturing creative insight and enable the cultural shift to take into consideration our broader environment. "Real scientific insights are creative *and* innovative."

HISTORY OF REAL TIME TECHNOLOGY ASSESSMENT

David Guston and Daniel Sarewitz conceptualized and designed Real Time Technology Assessment and were invited at the Workshop to speak about their experiences with and hope for it. Guston was then interviewed to recount the history of RTTA and how the visions have matched the realities.

Real Time Technology Assessment (RTTA) has been an evolution of successive, pragmatic reconceptualizations. The first concept was a proposal to the National Science Foundation (NSF). In the fall of 2000, Dan Sarewitz and I responded to the first round of request for proposals (RFP) that focused on the societal aspects of nanotechnology. Our proposal brought together our respective work at the interface of science studies and science policy that also merged academe and practice. While conceptually innovative, it was a collection of insufficiently vetted plans that lacked a coherent vision. Coupled with NSF's lack of experience conducting interdisciplinary reviews, the proposal was not funded.

Dan and Michael Crow complained to the administrators of the competition at NSF about the review process. We all felt that the proposal had been misunderstood and inadequately reviewed. One reviewer saw the proposal as anti-science and a futile effort at manipulating the scientific process. Another felt we were apologists of nanotechnology, working to make the world safe for nanotechnology. The third was favorable. Yet these strange and distinctive reviews led us to write letters to the NSF director and Mihail Roco asking them to get serious about the review process. Michael and Dan also visited Joe Bordogna, the Assistant Director of NSF, explaining how and why the review processes were insufficient and that while we were interested in resubmitting, we wouldn't without a guarantee of appropriate infrastructure.

We then decided to craft the proposal into a clearer, more concise, somewhat more visionary academic piece. We wanted to generate more discussion and interest that we could use to rework a proposal for the next round of funding. This piece became the RTTA paper published in Technology in Society in 2002. If you examine the footnotes you will see that we gave credit those who contributed text on the technical areas and social science perspectives in the earlier proposal.

Dan and I were in touch, somewhat casually but expectantly, about the anticipated Nano-scale Science and Engineering Center/ Center for Nanotechnology in Society. The RFP came out during the 2004 Gordon Research Conference, just after Dan arrived to start CSPO at ASU and around the time that I had agreed to join him. Thus the RFP came at a time that we could seriously consider how to institution-build for and through the NSEC program. During the GRC, Barry Bozeman, Frank Laird, Ed Woodhouse,

and Michael Crow joined Dan and I in clandestine conversations that articulated the beginnings of the Center for Nanotechnology in Society at ASU.

The next pragmatic step in RTTA's evolution was how to realize the methodological program that the paper laid out in the context of an institutional program that we could actually build at ASU. Changes from the paper to the NSEC proposal included dropping the historic and analogous case studies as a component of RTTA. We moved orthogonally and had the Thematic Research Clusters (TRCs) address similar challenges. Yet most of the paper is there, modestly rearranged and sometimes modified opportunistically. For instance, we added workforce assessment, which was conceived as a way to extend the operation of CNS as a boundary organization by bringing together a community of users of nanotechnology, particularly from industry.

Once funded and underway, I was surprised with the emergent need to develop the strategic level vision, a vision eventually conceptualized as anticipatory governance. If you go back to the paper, Dan and I use "anticipatory governance", but do so in an ambiguous fashion. How anticipatory governance emerged as a way to give more coherence and stability to the programmatic structure around RTTA was unforeseen. The anticipatory governance agenda was developed in a robust and collaborative fashion, and I have been impressed with how people have taken it into their work.

Another surprise, perhaps naively has been that the conflicts I've experienced between program management and program intellectual development have been real and at times have had a negative impact.

Less unexpected was the need for the End-to-End projects as explicit activities to stitch together the different RTTA programs. Dan and I had rather complicated visions about how the RTTAs would relate to each other, although we never articulated that fully in the proposal. But we knew, for instance, that the NCTF had potential as a centripetal activity that would need to draw data from the wider activities of the Center. We also imagined the scenario development activities would knit together the Center. Indeed, in the proposal we prefaced each TRC with a scenario.

It's astonishing that we haven't had to recast the structures originally articulated. The translation of the original intellectual ideas to the institutional design has been robust. We've made personnel changes and changes to the way things operate, but we haven't had to rearrange the intellectual and functional components. We talked a lot in the early days about our a priori assumptions about why enhanced reflexivity being a good thing. If people are more aware of the context they are working in and the choices they make, then their option space is expanded. This central notion is still intact, though still requires deeper scrutiny.

When Dan and I initially conceived of the CNS we designed something that was interactive and not stove-piped. We described a program and intellectual structures, but we knew they wouldn't stand, that they would need to be broken down. I am exceptionally proud of the way the Center has integrated what in most circumstances would be separate research, outreach and education activities. The seamlessness in which people operate is really quite wonderful. Overcoming the required programmatic structures to have center-wide activities and identities through the largely autonomous actions of individuals with their own inspirations, interests and training has been great. It is ironic and frustrating to write the NSF annual reports within the programmatic categories we described when, through center interaction, the categories have rightly eroded.

However well thought out CNS has been, many of its successes have been plodding, incremental and haphazard. The challenge going forward is moving from this mode into a more planned, intentional force.

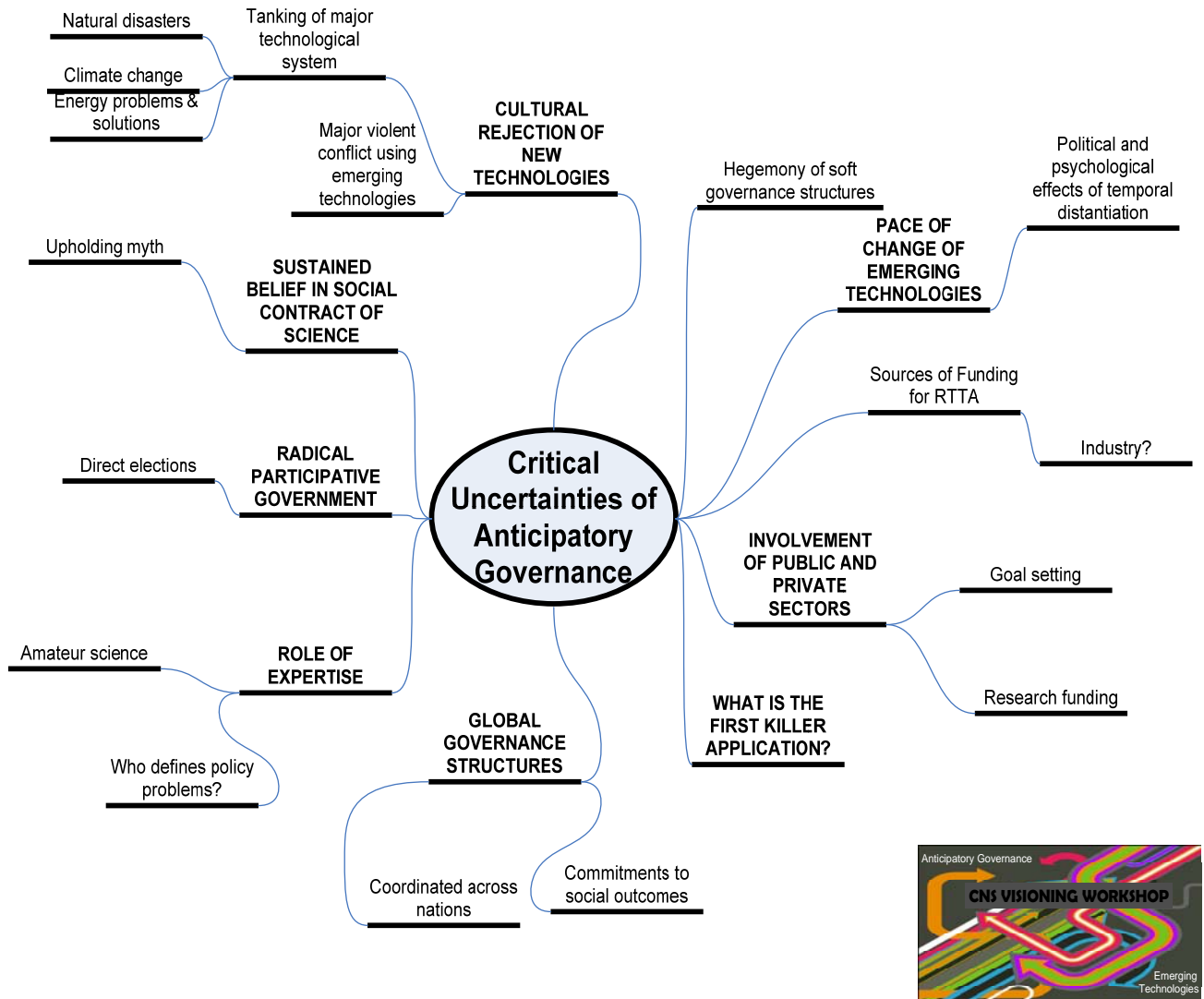## KEY DRIVERS OF CHANGE RELATED TO ANTICIPATORY GOVERNANCE

Our first discussion focused on the key structures, ideas, and trends that affect the future of anticipatory governance. These "driving forces" are those factors like institutional support, funding arrangements, public interest in new technologies, political persuasions, economy, speed of innovation, etc. that condition what anticipatory governance could look like. We worked to consider social, technical, environmental, economic and political change. In scenario planning parlance, these driving forces are reducible to those factors that are *Predetermined* or *Uncertain*.

Predetermined elements are "those events that have already occurred (or that almost certainly will occur) but whose consequences have not yet unfolded" (Wack 1984b: 77). Predetermined elements can be slow moving, like demographic change, or thoroughly entrenched, like democracy in America and "by already existing, [they] constrain or determine the future in important ways" (Tibbs, 1998: 8). What factors will certainly influence the success or failure of anticipatory governance? What are those forces we can take for granted, that will endure into the future?

While accounting for predetermined elements is important to ground the scenarios, the core interest in scenario planning is to hone in on the critical uncertainties. Critical uncertainties are those forces that will impact the focal question in profound but relatively unspecified ways. The process leading up to the scenarios thus enables a group to think about known and unspecified sources of change.

The issues and tensions raised during the brainstorm were captured on 3M post-it notes and then collectively categorized. Participants were then asked to determine which forces they thought were most important and most uncertain. The map on the following page captures their ordering and ranking.

Natural disasters

Tanking of major technological system

Climate change

Energy problems & solutions

Major violent conflict using emerging technologies

CULTURAL REJECTION OF NEW TECHNOLOGIES

Hegemony of soft governance structures

Political and psychological effects of temporal distantiation

Upholding myth

SUSTAINED BELIEF IN SOCIAL CONTRACT OF SCIENCE

PACE OF CHANGE OF EMERGING TECHNOLOGIES

Sources of Funding for RTTA

Critical Uncertainties of Anticipatory Governance

Direct elections

RADICAL PARTICIPATIVE GOVERNMENT

Industry?

INVOLVEMENT OF PUBLIC AND PRIVATE SECTORS

Goal setting

Amateur science

ROLE OF EXPERTISE

Who defines policy problems?

GLOBAL GOVERNANCE STRUCTURES

WHAT IS THE FIRST KILLER APPLICATION?

Research funding

Coordinated across nations

Commitments to social outcomes

Anticipatory Governance

CNS VISIONING WORKSHOP

Emerging Technologies

PREDETERMINED ELEMENTS

Participants decided that the following drivers were bound to play a large role in shaping the configuration of anticipatory governance.

The following predetermined elements underpin the scenarios. As forces perceived to certainly persist, they are expected to structure the future of anticipatory governance:

- Concentration of R&D in multi-national firms
- Regime change in the global regulatory systems
- Public perception of science - moral change, risk aversion
- Distribution of economic risks
- Strength of civil societies
- Demand side "make it for me" technologies will gain popularity
- Demographic: aging population; over/under population
- WOMD will be easily available
- Increased strife over resources like water and food;
- ET will cause dislocations in finance and firms
- Public surveillance on the rise
- Disappearance of legitimatized sources of public information

DEVELOPING THE SCENARIOS

From this specification of critical uncertainties, participants were guided to construct a scenarios matrix, which served to structure the main themes into four "worlds."

Each world set the conditions for the scenarios along 2 axes:

❖ **Technologisity**: This dimension correlates positive and negative to the question: Do you think technology makes life better? On one end of the spectrum is skeptical of new technologies without evidence to support the proclaimed benefits. The other side embraces technology and is willing to trust and adopt new technologies on faith.

❖ **Governance**: This dimension captures the degree of openness of governance processes, structures and propensities Open governance implies transparent, participative decision making, while closed governance implies the opposite and evokes centralized power and decision making.

		TECHNOLOGISITY	
		SKEPTICAL	EMBRACING
GOVERNANCE	OPEN	**Eco-World**	**Martyrs for Progress**
	CLOSED	**Innovators of the Apocalyps**	**The Grid**

THE SCENARIOS

The matrix served to provide scaffolding for the scenarios by synthesizing the complex array of issues into frames broad enough to capture the rich brainstorming, yet distinctive enough to produce divergent, plausible futures.

What follows are the scenario narratives which were developed in teams during the workshop and elaborated and written up by:

❖ Beate Josefine Luber and Cyndy Schwartz (Eco-World)

❖ Sharlissa Moore and Antonio Calleja-Lopez (The Grid)

❖ Shannon Conley (Innovators of the Apocalypse)

❖ John Carter McKnight (Martyrs for Progress)

Eco-World

Summary: Eco-world is an environment where governance processes are becoming more open and transparent and where citizen's participation and influence in democratic decisions is the norm. Congruous with an expanding, adaptive infrastructure is the modulating effect of society's skepticism towards technology as the scientific cure-all. Citizens' attitudes toward and selections of particular technologies are driven by a reflective view of possible societal outcomes.

Linda's Day in Eco-World: Selective technology utilization in an open participative society

It's Saturday morning in Eco-World. Linda looks out of the extra-insulated window of her condo-complex and discovers her seventy-five years old mother surrounded by kindergarten kids that are listening breathlessly to one of her famous spine-chillers. Her mother works part-time to support the comprehensive state-funded 'Baby-boomers Boost Society' (BBS). Such initiatives foster societal involvement of retirees which constitute at least 40% of the population. Her father, a retired cabinet-maker, is also involved in this initiative by advising an environmental group's project on the preservation of craftsman knowledge, which is seen as a useful resource for producing new technologies on the basis of traditional knowledge.

Linda sends her kids to visit their grandma in the garden while she picks up some staples at the corner market. She takes her bike that is always handy near the front door and bikes 1 ½ miles to the grocery store. Entering the market she gets a 'Magic Info' device that screens the item and informs her about the product's entire life cycle with regard to waste production and energy consumption. Linda remembers a particular blog on the consumer websites that explained the reason for this innovation: "The creation of awareness and competency building of the consumer are the 'keys to the diffusion of innovation'", one blogger wrote. At the cash desk, Linda focuses on a woman that has only conventional non-organic food in her shopping basket. "Look at that unhealthy stuff. She will probably give it to her children. How nasty!" she thinks. Linda is about to tell the woman some basic truths about organic food but she decides rather to write a blog entry about this. "You cannot change these Non-organics anyway. They are just stupid.", Linda thinks to herself.

At home she has time to check the news on the current election issues -- 'The inclusion of surveillance and genetic screening selective technologies in the health sector'. Linda is glad that this concern is discussed by old and young, rich and poor. Around ten years ago the government implemented a crucial plan to make sure that everybody had free access to the internet and to computers in all public institutions. She agrees that the various websites are the most effective means to easily inform political representatives as well as the citizens about public opinion on different topics.

The current issue is a real head-scratcher for Linda. Since the healthcare system is overburdened by the rising need for health maintenance for the 'baby-boomers', genetic screening methods seem to be a solution. Linda thinks of the argument of her old daddy: "See, my doc told me that you can diagnose, treat and even prevent diseases. Think about what this means for our family pre-disposition towards diabetes! And guess what: I am for compulsory genetic screening since this is the easiest way to develop appropriate medicine for all of us. You are the most socially responsible of us, you have to know that!" Linda couldn't avoid a sardonic laugh, "Yes, but in the inept hands of my lovely chef it could be a little bit more difficult." Because the population contributing to genetic screening is a much smaller demographic group compared to the retirees, she believes that the facts about privacy concerns may be underrepresented on the discussion websites as well. Linda hopes that the political parties take this into

account since the website elections are 'merely' mechanisms to inform the representatives about the public voice. She wishes that her favorite politician personally internalizes the citizen's viewpoints, although she cannot fully trust his discernment since he recently confessed that he loves to drive fast sports cars from time to time. When Linda gets angry about politics, she tries to always remember the improvements instituted since the 'old dark times' – as she called it. *Many things have changed in the last fifteen years…*

When looking back at history, Linda recalls when the regional communities across the country acknowledged the need to reduce their carbon footprint and were ready to embrace change. And fortunately, the elected representatives listened to the on-line voter's opinions. She recollects the famous headlines (which continue to alter her daily life), "Majority of On-line Voters Agreed on Comprehensive Renewable Energy Program".

Linda is very pleased with her condo-complex (consisting of one and two bedroom units in a 20 story building) which was designed with concentrating solar parabolic troughs (for electricity) and geo-thermal piping (for winter and water heating). The new technology systems installed for the complex were partially funded by the state, paid from taxes imposed on oil consumers.

"Mom, when do we go?" whined the five year old. Linda prepares for the ride to the countryside and organizes the clothes and food totes on the bicycle side bags. "I want the red one!" notes the three year old, as Linda signs the registration slip for one of the regional 'fleet bio-fuel cars' which are available for anyone's use, located at the end of the light rail parking lot. Linda had recently received training in order to use the car's 'advanced selective technology' features. Linda loads the totes and children, and drives into the bio-fuel station. The pump's scanner recognizes the vehicle's RFID prior to fueling. Eco-friendliness is rewarded: Linda pays the lowest amount. She is satisfied in the belief that her on-line opinion helped to support this most recent technological improvement in the last election.

"Are we there yet, Mom?" the little one repeatedly mentions during the hour long drive. Linda and the children have a great time in the countryside cabin. During the children's naptime on Sunday, she is able to get a little more done on her project for her job. Linda, like many young stay-at-home mothers, utilizes the computer to perform a respected and valuable job. In her role as Internet activist, Linda works as an on-line newspaper woman - searching out expert's stories of new technologies and reporting on newly patented innovative possibilities for improving people's lives. She frequently writes about subjects like, "Public's skepticism towards embracing technology is based on sound and valid reasoning". Linda's literary output on the "Eco-News" website allows many viewers to read about the societal benefits of the proposed innovation -- without merely being bullied by market interests. She is happy in her job and enjoys performing her informative role to aid society in the decision-making process.

Innovators of the Apocolypse

<u>Summary</u>: In the year 2025, a cyber terror attack brought the global technology market to its knees. By the year 2050, a new regime has come to power, known as the RESCon (Religious Environmental Social Conservative) Government. The RESCon Government gained favor with the populace because it promised it would never allow the circumstances to arise in which society would be vulnerable to another terror attack. Wary of science that promotes unconstrained growth, the Government only provides its scarce resources to researchers who conduct science that falls in line with its values. These resources include not only money, but electricity, subjects, and engineering shops. The Government employs elite scouts to find scientists who have the talent and willingness to conduct RESCon science, and also to suppress and eliminate rogue innovation. There is another force in this world, a community of rebel scientists and their supporters, which Adam Kelly is a part of. Adam performs a dangerous and vital task – he conducts covert real time technology assessment in a post-apocalyptic world. The below scene is a small vignette which is part Adam's larger story.

<u>Cambridge, Massachusetts: 2050</u>

Adam's concentration was abruptly interrupted by a familiar voice.

"Let's go."

Adam turned around and shot a glance to his partner, John.

"We can't leave yet," he said. "We haven't spoken to everyone here and I need to record the experiments in the southwest corner of the building."

"We don't have time for that, Adam," John said, his impatience becoming increasingly apparent. "It's either we leave now, or we die. You choose."

"Oh come on," Adam smirked. "They won't kill us right off the bat—we'll rot in jail for 10 years if we're lucky."

Although John usually appreciated Adam's fatalistic humor, Adam could tell it wasn't working now. Something was really bothering John. Adam's face became serious.

"Do you really think that they're on their way?" he asked. "What about this lab? There's no way they could have found it. It's one of the most covert operations in the state right now. What about the scientists and the apprentices…the experiments? They're so close to hooking up a micro grid. Just think—we would be able to communicate with one another across hundreds of miles, just like the old days! If Dr. Moran is able to deliver what he promises, it would be like rolling back the clock, in a way. To how civilization used to be, how it *should* be. This world that we are living in, this isn't civilization. This is a throwback to the state of nature."

"That's all well and good," John said. "But even more important than this lab and these scientists and these apprentices is what you have in *that* book."

He gestured to the tattered leather-bound notebook in Adam's hand.

"All of Moran's data is in that book," John said. "All of the instructions, the history of the work, how we can replicate it—it's all there. If you get killed and they take your notebook, then that's it. It's over. Say goodbye to any possibility of restoring society."

John sighed.

"Look, I know that Moran is like an uncle to you," he said to Adam. "I know you admire him and want to save his work. I know all of this. The way you are going to do that is by getting out of here with that book."

Adam pretended to ignore John's words, choosing to stay crouched down, scribbling furiously in a silent protest.

Adam knew that John was right. He still wanted to stay at Dr. Moran's secret lab and fight the RESCon forces that were nearing. It wouldn't do an ounce of good, though. This was the nature of the battle. The RESCon hunters would inevitably find out about an isolated lab, track it down, and destroy it. When they destroyed it and arrested the scientists, they did more than destroy something physical—they destroyed hope. The RESCon forces didn't even have to be violent in their methods. When scientists were discovered, they knew it was the end of the line. They usually went peacefully, because the alternative was isolation for years on end in a cold, dark cell. The rebel scientists that cooperated with the RESCons would still do science in jail, but it wasn't the type of revolutionary science that would lift the world out of the silence and darkness it was now shrouded in. It was RESCon science, based on RESCon values and RESCon priorities. The scientists would work on natural resource extraction methods, finding new ways to power the RESCon seat of government—a dilapidated Washington D.C., the former U.S. Capital. The cyber-terrorism in concert with a RESCon takeover had caused innovation, progress, trade and communication to be brought to a screeching standstill. It was more than a standstill, though. Innovation just didn't exist after 2025. Science outside of the RESCon government had been reduced to the tinkering of a few rogue scientists.

Some scientists were lucky though. Adam and John, and other revolutionaries like them, were sometimes able to warn the cells of rogue innovators, giving them enough time to escape the RESCon hunters, but not enough to save their work. It was Adam's job, as a horizon-scribe, to record everything that he saw in the lab. Depending on how much time he had, he would conduct detailed interviews of the scientists and their apprentices, writing down every word. He copied their diagrams, charts and plans in perfect detail. Through clandestine training by the SUN-W (Scientific Unity for a New World) alliance, Adam had learned techniques that would enable him to remember and recite detailed scientific information almost perfectly. His skills and abilities were unparalleled. So it wasn't just what was in Adam's book that was important, it was what was in his *head*. John's annoyance at Adam's reservations to immediately leave the lab made sense, since Adam was an invaluable resource to the SUN-W alliance, and John was appointed by the alliance to be Adam's partner and bodyguard.

John's gun, an artifact from 1990, was now in his hand. The flickering, generator-powered lights glinted off of it.

> "We are going now, Adam," John said. "Stop writing, and let's get the hell out of here!"
> Adam set his book down and finally looked up at John.
> "Okay," Adam said. "Does Dr. Moran have everything packed?"
> "Yes," John replied. "He and the apprentices are ready to go. We're waiting on *you*."
> The two SUN agents made their way across Moran's lab, up the stairs and out of the basement.
> Emerging into the brisk autumn air, Adam shielded his eyes from the late afternoon light. He faced his old friend, a tall shadowy silhouette against the waning sun.
> "Dr. Moran, I guess this is it," he said.
> Jason Moran smiled, habitually adjusted his glasses and patted Adam on the back.
> "If it wasn't for you and John, everything would have been lost," Dr. Moran said. "We wouldn't have even known that the RESCons had us on their radar."
> "It's still such a shame though," Adam said. "You and your team were so close to transmitting a signal to the satellite."
> "The only thing that we can do is start over, Adam," Dr. Moran said. "You know this—you've been through this same situation hundreds of times."
> "Yes I have," Adam replied. "But I am also well aware that your work is the closest to a major breakthrough in over a decade."
> John interrupted.

     "The horses are ready—let's head north," he said. "The RESCons can't be more than 20 minutes away. I'm just glad it hasn't snowed yet, so they can't see our tracks. They'll assume that we are heading for the old MIT campus and head in that direction. That will buy us some time."

     Their boots crunched on the layers of dead leaves, a red and orange blanket covering what had been a parking lot decades ago. The current scene before Adam hardly represented the city that used to be a bustling hub of innovation and ingenuity. Instead, the formerly modern world of Cambridge, Massachusetts was sinking back into a deep wilderness. Ivy crept up the rusted streetlights that still stood, nature appearing to assert itself upon the ruins of a once-great society. Adam chose not to think about it, though. It did no good to attempt to imagine a world that no longer existed.

The Grid

<u>*Summary*</u>*: This is a society where technologisity is high and governance is close. The catastrophic market crisis started in 2008 unleashed a hard and long struggle for survival among companies. Many enterprises of middle and large size recurred to fusion and state aid, what disembogued in the consolidation of political and economic power into huge hybrid, cross-sector monopolies. Social, economic and environmental problems become rampant, and daily life got a dark profile. As in many previous periods of uncertainty, pessimism and fear in human history, societies looked to psychological sedatives and stronger forms of authority as solutions. The leadership structure consists of an elite group of academic, business, and political leaders designed to foster international coordination between multiples organisms for economic stability and control.*

Bring bring! John's alarm rings at 3am. He glances at his calendar, which reads October 28, 2050. In a tired haze he stumbles into the kitchen and gropes through the drawer for his bottle of pills. He is jolted awake when he doesn't find them there. Panicked, he turns on the light, searching frantically until he uncovers them under a stack of job applications. He knows the small, spherical pills will clear his foggy brain; they are necessary for starting his day, for achieving happiness and fulfillment in his life. He thinks back on happier days- several months ago- before he lost his job working the assembly line at a factory that assembles nanocrystals. But he has faith that the pills will restore his happiness. The 'magic' pill taken, John switches on the TV…

John scrolls through the programming options- American Idol, Better Living Through Drugs, a football game, the latest Disney movie, an interview with the governor… American Idol wins; the finale between his favorite singers is on this morning. John is excited to place his vote through the interactive online voting system. The program is soon interrupted by a commercial for the pills John took this morning. A perky and attractive young woman appears on the screen.
> "Earlier this year, I was lost, tired, and confused. Then my doctor, friends, and family recommended HighEx. Now I am happy, satisfied and in love with life! Stop by your local pharmacy today so that you too can achieve the ultimate happiness! … This product certified by Citizen Technology Assessment."

Several hours later, his scheduled TV-watching time complete, John moves on to the next task on his agenda, appreciative of the structure in his day, which combines work with leisure. He turns on his computer, and this morning's product ballot appears. He begins by placing a vote for the microchip phone implanted in the neck, which is operated by head motions. He prefers this to the wrist model, which would require tapping his wrist instead of head movements. He then votes a new version of HighEx, which will only have to be taken once daily, over the three times daily pill or the once daily injection. The once daily pill seems to be the most convenient option- easy to remember and no careful handling of syringes required. He is particularly excited by the mounted pill dispenser, which will prevent any further episodes of lost pills. After he is finished, a message pops up on the screen:
> Thank you for participating in Citizen Technology Assessment. This opportunity funded and provided by the Commission—"we care about your opinion."

John smiles; he is content with the knowledge that people with abilities superior to his own are in control of the nation but still provide citizens with outlets for participation. It was time for his afternoon pill.

Pleased with daily his civic participation, John logs into the virtual university. He has three classes this morning: facts and dates about the Roman Empire, solar fusion, and cartilaginous fishes. There is a test at the beginning of each class, in which he must recite facts he learned in the previous day's class. He later receives lessons in Citizen Technology Assessment, where he learns how to participate and improve technology design. Afterwards, he participates in factory training. While it is optional and unpaid, he knows it is necessary to emerge from unemployment status and land a job at another technology factory. This will provide him with the funds to upgrade to a better version of HighEx. Once he finds a job he will still take classes—all citizens do—but they will take up a smaller portion of his day. Tonight, friends are coming over to watch the football game. After his friends leave, he begins his homework; he has a lot of information to memorize before tomorrow's classes.

The governance in this society is so closed that the leadership structure is black boxed, which is why we only have a vague analogy for how the Commission works and why John knows little of the leadership structure in his world…
In Jonh's world, the Commission is run by a small group of hegemonic and enhanced political, military, and corporate leaders. They control the various actors in the grid, through mass media, social and educational structures, as well as diverse psycho and nootropic drug-systems. Every relevant organism is a part of the Commission's plans, including the organizations John looks to for protection, such as the Army, Navy, and Air Force; those he looks to for leadership, such as political parties; and those he looks to for entertainment, such as Disney, Fox Television, and the NFL.

Everyone is ostensibly on an equal playing field except for the Commission members, who steer almost everything. The Grid is governed by predictive government, instead of anticipatory governance, which has become a shade of what it was expected to be by the twilight of the third millennium. Technology is the crucial vector of socio-economic transformation and control in the Grid, but technology assessment is just an inconsequential routine. Its exitus has a Janic face: looking forward to its socio-economic implementation, it's all success; looking back towards its original and moral goals, it's all breakdown. Though John does not have the time, the inclination, or the mental clarity to see it, all social problems in the grid are designed in advance; poverty and wealth are scheduled and cycles of unemployment/ employment and disease/health are preplanned. Ninety percent of the productivity in the society results from technological infrastructure and only a small percent of it results from human labor. The technology simultaneously allows nurturing, controlling and making redundant the workers. However, employment, technology assessment and education are useful, planned tools for social control and conformism in the Grid.

John finishes his day's work by meticulously rechecking his schedule for the next day. He goes to bed at midnight, setting his alarm for 3am, when he will wake up, take his HighEx, and begin his day again.

Martyrs for Progress

<u>*Summary*</u>*: In a world where enhancement technologies are readily available, power is decentralized, information ubiquitous and technology assessment is taught in grade school, one young entrepreneur confronts the price of progress…*

Terence Dumont Tranh, "Terry" in vocal and "*" online, slid gracefully into his favorite seat at Locally Responsive Coffee, the hangout he held an investment stake in. With eyeblinks and a little subvocal, he ordered his usual green tea soy latte, the transaction arranged between the software agent who did the "work" part of his work, Cynthia, and the café's equivalent managing agent, confirmed with a silent-message wink and grin from the barista, his investment partner and occasional girlfriend, Palladia.

Terry's internet-networked contact lenses provided an information-rich display much like the "desktop" of a computer from previous decades, enabling his attention to flicker between several text-chat conversations, a stock ticker, his news feed and a music video, amplified by bone-conduction audio (Terry'd lined his sinus cavities for enhanced bass-response, and thanks to customized allergy medicines, they stayed clear and echo-free all Spring).

"Green tea soy latte, not too hot," Palladia said as she set the drink on Terry's table. "So what's your morning like?" the lean barista asked.

"I'm tweaking the networked display interface for the tidal power coop - they had a bunch of complaints about their graphical data presentation, so they dumped it on me to come up with something you don't need six months of power management training to read."

Pally smiled down at Terry, her hip tilting to barely brush his shoulder. "Good gig?"

Terry grinned up at Pally: it was a good gig, drawing on a talent for interface design he'd shown as a kid and honed with apprenticeship to master graphic artists, going beyond standard tele-presence training to spend three months cleaning paintbrushes for a Zen calligrapher in Bali. "5k easy - you know how cranked people are here about the big-infrastructure crap. Add a failure or martyrdom in the power sector globally in the next couple weeks? Bump that tenfold." There hadn't been a martyrdom – deaths in a tech-based mega-disaster – in nearly seven weeks, and Terry had most of his fortune riding on a big one happening in the next few days, but not in his field!

Terry and Pally froze in mid-conversation, their attention diverted to a priority news announcement flashing on their contacts: PORT OF LONG BEACH DESTROYED – LOW YIELD NUKE – EXXONMOBIL JIHADIS CLAIM RESPONSIBILITY

"Woooohooo! I'm STINKING RICH!" Terry leaped to his feet, toppling the remains of his latte and sweeping Pally into an embrace.

Late that evening, Terry lit a candle as he sat seiza on the floor of his apartment, still surprised by the religious awakening he'd had. Calling up a mix of Tibet-hop and electro-dervish (throat singing made him sneeze, so he stayed away from tuva-pop, hot as it was this week), he asked Cyn to tune his brain chemistry for a bit of rapture as he mused to his lifelog about the day.

lifelog daysummary composed 10202005 2200 GMT-8: I saw it coming, and I didn't need that financial-analysis package of software modules for Cynthia and cognitive enhancers for me that turned my life

around after I went bankrupt in Bali. It was dead obvious the ExxonMobil Institute of Global Jihad was going to try to score a big one fourth quarter, after last semester's humiliating failure to release monkeypox at the TED conference. Only question was which way to surf, up the environmental cleanup stocks or down the nuke-security complex. I bet big, won big, up better than 4M by lunchtime.

Disasters happen, right, that's the price of freedom, and not having cops and bureaucrats and soldiers. We learn from our mistakes, improve our security, and, well, some people get rich and some end up martyrs. Me, I'd been betting smart: martyrdom was for chumps, anti-enhancers and people with bad luck. I figured I got all my bad luck early when I lost the bundle I made from my high school honors company (yeah, even anti-enhancers know better than to give their root password to a hot blonde stranger. Hey, it was Bali, I was 17. Still, it wasn't a fun year of cognitive therapy). The only question was, was I smart enough to be rich?

So yeah, I was feeling millionaire-smart by lunchtime, and had Cyn tweak my neurochemistry for a nice smooth high –

Until Pally's friend Selina dropped by the café, in tears, from watching the tribute videos for the martyrs at the Long Beach bombing. Okay, I teased her a little – but I wasn't expecting a four-hour religious lecture!

And I wasn't expecting a religious awakening. Yeah, I had Cyn give me a limited dose of the "Rapture" neurochemical package, but just to punch up the experience a little.

You know, I never got catechism class – I mean, the whole point of the New Education movement was to teach kids what they need, normal stuff like trend analysis, innovation forecasting, rhetoric, statistics - not the weird-ass stuff people did in school in the twentieth century. So why make us work through modules on democratic transhumanism, Bhutanese happiness accounting, eco-shamanism, Martyrdom Studies, all that crap? I'd worked an override on the student contact lenses, and mostly watched music videos.

But Selina, the way she talked about the Long Beach 73, it made it real, you know. You can see the old Moffett Field airbase from here, that's now the agro-nano coop, but it used to be the US government and warplanes and state security and all that crap, and how many people died in 09 when that whole state-capitalism thing collapsed?

So yeah, been thinking about the martyrs, not just the 73 but all of 'em, who died for freedom and progress…

<*> Cyn, set me up a three month training at the Shrine of the Martyrs: Tibetan finance, viridian design, Zen forecasting – and a couple modules of kama sutra, all work and no play, right? no confirm, just book and calendar per default parameters. aw, hell…

<*>Cyn, tithe 10% of today's profits (Cali GAAP, load definitions current 0838 GMT-8 this morning) to the Shrine of the Martyrs, tag "early childhood ed donation," make it anonymous, ok?

<*>but I'm serious about the kama sutra module, Cyn…

Newly pious, newly rich, Terry blew out the candle and called it another day in paradise.

HISTORY OF THE FUTURE

Participants were asked to spend 20 minutes writing a History of the Future that captures their ideal version of and outcomes associate with Anticipatory Governance as either 1) a historical account of CNS in 2015 from the vantage point of 2025; or 2)their CNS career obituary. What follows are snippets from their Histories…

"In 2015 CNS had established an extensive network of 17 centers throughout North America and Europe, with plans to open 6 more in the southern hemisphere (South America, Africa, India, China, etc.). Approximately 60% were co-located with universities, 20% with corporations, and 20% with INGOs…CNS research methods include interviews, observations, surveys, focus groups, town hall meetings, press releases, exhibits, science cafes, and potluck dinners."

"CNS became a "sabbatical center" for scholars and practitioners from around the world and "downtime" at CNS is seen as a significant step in professional development"

"Looking back at the impact of CNS, we can see that it was a transformative institution. It pioneered new ways of gathering and synthesizing information and insights into emerging social phenomenon, a new industry based on a fast-moving science base. Part of this accomplishment was bringing together social and natural scientists. But more importantly, CNS found ways to give authentic voice to a wide range of the people who would be affected by nanotechnology. Those voices changed the political agenda with regard to the field, redirecting public efforts towards applications that answered basic human needs."

- "CNS had been renamed "CATS" – Center for All Technologies in Society
- The idea of RTTA had become central to the notion of "responsible design" and "responsible innovation"
- CNS/CSPO had small satellite centers in each college at ASU. All labs at the Biodesign Institute were connected to "societal outcome labs" run by CNS/CSPO faculty."

"Ideally, but somewhat practically, in 2015 we would see a better understanding between social and natural scientists of the goals of RTTA and would be working towards forming a consensus between the two communities as the role of RTTA/ RTTA would be on more research's radar screens as something that would be useful in their work, and it would be registering with federal policymakers as a useful too."

- o "We were requested to establish and proliferate "reflexive government" teams across federal, state and local agencies and sub-agencies. We set up training classes which included "hands-on" scenario examples of plausible situations for emerging technologies.
- o Funds were provided and used to require an "RTTA" element for all federal, state, and local funds. There is now a requirement to hold participatory, thoughtful debate with a holistic approach to the "big picture" relevant to new/emerging technologies.
- o This included a new "science" of pre-mediated thought and approach to reviewing technological changes/improvements to society through "what if" scenarios which consider the effects to society at large. There are now mandatory, highly motivated, involved members that review future technology for all social elements."

"In 2025 the notion of a "center" is as quaint as that of a "factory" – the notion of production in a bounded place by an identifiable group working 40 hours a week at one enterprise is long dead."

"Global STIR goes beyond dialogue, however; the interactions between the natural and social scientists actually enhance the scientists' awareness of the broader impacts of their research."

BARRIERS AND CARRIERS

Participants were next asked to keep their visions in mind, and return to their scenarios:
1) What are the barriers working against your visions? List the challenges.
2) What are the carriers working for your visions? List the opportunities.

The Grid

Barriers	Carriers
• Decision-making is too closed • Lack of true (meaningful) collaboration • Lack of real access • Dominance of market values (no room for social, environmental . . . values) • Dilution and under-specialization	• RTTA is institutionalized • RTTA is popularized • RTTA is well-funded • RTTA is interdisciplinary, participatory • Universal access to education

Eco-World

Barriers	Carriers
• National technology choice neglects solving global problems • Corporations not currently held responsible for social outcomes • Rogue innovators – not part of government-industry • Diversity of opinion • Training large numbers of RTTA practitioners	• Open institutions embracing RTTA • Broadly supportive culture • Civil society already organized • Government-industry positive interaction

Innovators of the Apocalypse

Barriers	Carriers
• Fragmentation of knowledge system • Trust as a scarce commodity • Regimented and highly structured value conflicts • Roles of coercion <u>or</u> transgression	• Values at the heart of what governance discussion exist • Once formed collaborations are real commitments • High (level of awareness innovation → variety of practice of RTTA) sensitivity to socio-technology (reflect awareness), trade-offs, trajectories

The Dalai Lama's Hotdog

Barriers	Carriers
• Counter values (towards 'individualization', state, military power) • Large scale security breakdown	• Deconstruction of institutions • (early) education reform • Unity of technology and humanism • Unity of innovation, analysis, precaution, etc. (co-construction) • 'Normalization' of 'RTTA/AG'

DESIGNS & DECISIONS: THE STRATEGIC CONVERSATION

The conversations conducted during the workshop were the main outcome:
Bringing together individuals to discuss anticipatory governance in itself makes headway into responsible, socially robust development. However, we did challenge ourselves to come up with actions that should be taken to ensure a productive role for anticipatory governance in the future.

We asked:

❖ What **actions** can and should be taken to bring about the best possible manifestation of anticipatory governance?

❖ What are the **implications** of this workshop for our work? What does this thinking mean for what we do?

❖ How can we **apply** the learning? How might we work differently?

TRAIN BABY, TRAIN
- Require anticipatory governance class for scientists and engineers
- Modularize
- Get more CNS/CPSO students: Reach out to young people who could be the next generation of RTTA

DEMONSTRATE & TRANSLATE
- Develop specific policy options, briefs and opinions that government can use
- Articulate specific examples of success
- Demonstrate actual value-added from RTTA to decision-makers
- Demonstrate reliability of public engagement techniques
- Write RTTA in the language of other disciplines and for non-academic audiences
- Utilize real-life narrative/story to convey ideas to public/other scholars

REACH OUT: *disseminate, explore, sell*
- Identify decision maker needs and provide RTTA solutions
- Develop ways to identify and link to TA currently being done in corporations and government

To the BUSINESS WORLD

- Engage business-leaders and staff
- Infiltrate corporate R&D teams

To the POLICY/GOVERNMENT WORLD

- Acknowledge importance of the "local" → reach out and dialogue with local government/institutions
- Provide "RTTA approach" to government (federal, state, local)

To other STAKEHOLDERS

- PBS 60 minute show explaining RTTA and its benefits and how individuals can get involved
- Open public(s) recruiting offices – build a large pool of interested citizens
- Work with various civil society groups & NGOs

RESEARCH DIFFERENTLY

- Analyze on a global basis
- Understand innovation system coordination
- Experiment with anticipatory and foresight inputs into R&D

BE DIFFERENT

- Experience constant value contestations in close proximity to R&D decision-making
- Look for anticipatory governance to ("change") rhetorics
- Take a proactive role in fostering environments of trust

GROW

- Develop international projects/networks
- Develop training models for engineers, scientists, and policymakers that can be exported
- Clone CNS

FUNDING

- Pass the hat to an angel
- More funding: integrated component on government grants for technical funding, industry finding, foundation funding

PLAY WELL WITH SCIENTISTS

- Reinforce and restructure STEM incentives
- Experiment with collaborative socio-technical integration practices
- Create meaningful relationships between social scientists and natural scientists

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