Persistent Forecasting of Disruptive Technologies--Report 2

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PERSISTENT FORECASTING OF DISRUPTIVE TECHNOLOGIES—REPORT 2

Committee on Forecasting Future Disruptive Technologies

Division on Engineering and Physical Sciences

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Preface

Monitoring and harnessing the power of global technological innovation are necessary tasks for any nation that seeks to promote the well-being and safety of its citizens. Globally interconnected business, financial, social, and political networks connect more people than ever before to the positive and negative disruptive impacts of novel uses of technology. The increased spread of knowledge and opportunity throughout the world has been accompanied by an increase in technological innovation, particularly from smaller organizations and nontraditional sectors. The purpose of a forecasting system for disruptive technologies is to minimize surprise related to disruptive innovation and to prepare decision makers for the future. To assess current forecasting methods and aid in the development of a next-generation forecasting system, the Defense Warning Office of the Defense Intelligence Agency and the Director of Defense Research and Engineering requested that the National Research Council (NRC) establish the Committee on Forecasting Future Disruptive Technologies.

This is the second of the two reports requested by the sponsoring organizations. In its first report (National Research Council, *Persistent Forecasting of Disruptive Technologies,* The National Academies Press, Washington, D.C., 2010), the committee defines "disruptive technology," analyzes existing forecasting strategies and methods, and discusses in detail the characteristics of a long-term persistent forecasting system. In this report, the committee attempts to create a model for a buildable forecasting system incorporating many of the methods and characteristics outlined in the first report.

As chair, I wish to express appreciation to the members of this committee for their earnest contributions to the generation of this report. The members are grateful for the interest and assistance of many members of the technology and forecasting community, as well as to the sponsors for their support. The committee would also like to express sincere appreciation for the support and assistance of NRC staff members Michael Clarke, Daniel Talmage, Kamara Brown, Sarah Capote, and Shannon Thomas; Christine Mirzayan Science and Technology Policy Fellow Sarah Lovell; and technical writer Linda Voss.

Gilman G. Louie, *Chair*
Committee on Forecasting Future Disruptive Technologies

Acknowledgment of Reviewers

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council's (NRC's) Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report:

Andrew Brown, Jr., NAE, Delphi Corporation,
Natalie W. Crawford, NAE, The RAND Corporation,
Alexander H. Flax, NAE, Potomac, Maryland,
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Christopher L. Magee, NAE, Massachusetts Institute of Technology,
Raghunath A. Mashelkar, NAS/NAE, National Chemical Laboratory, and
Ray Strong, IBM Almaden Research Center.

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by Maxine Savitz (NAE), Honeywell (Ret.), and Michael Zyda, University of Southern California. Appointed by the NRC, they were responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

Contents

APPENDIXES

Acronyms

ARG	alternative reality game
DDR&E	Director of Defense Research and Engineering
DIA	Defense Intelligence Agency
DoD	Department of Defense
DWO	Defense Warning Office
IC	intelligence community
IED	improvised explosive device
IT	information technology
NIC	National Intelligence Council
NRC	National Research Council
QDR	Quadrennial Defense Review
TED	Technology, Entertainment, and Design

Glossary

1.0 system A minimal working system with basic core functions that is used by its target users as a production system. A 1.0 system is different from a prototype, which typically is a testbed used to validate an approach with a small number of users and has a subset of the required core functions. The label "1.0" is typically given to the first fully working product that is released to its target users.

accountable prediction A forecast with a specified end date and a testable, wagerable proposition.[1]

backcasting Exploring a projected future scenario for potential paths that could lead from the present to the forecast future. This can include the identification of *signposts* and *signals* that indicate the accuracy of a prediction.

back testing Evaluating an event that has already occurred to validate a forecasting methodology.

closed ignorance Information is available, but stakeholders are unwilling or unable to consider that some outcomes are unknown.

cloud computing A software model that uses remote servers to provide real-time delivery of services to customers by the Internet.

community of interest A group or collection of people trying to solve a common problem or having a shared concern.

crowdsourcing The act of outsourcing to the public or a selected subset of the public a function previously performed by employees.

data hygiene Principles and practices for removing errors and repetition from data in a database.

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[1]Definition adapted from http://lewisshepherd.wordpress.com/2008/05/25/is-it-even-possible-to-connect-the-dots./. Last accessed January 28, 2010.

data mining/data harvesting An automated process of extracting patterns from data.

Delphi method A structured approach to eliciting forecasts from groups of experts, with an emphasis on producing an informed consensus view of the most probable future.

disruptive technology Innovative technology that triggers sudden and unexpected effects. The term was first coined by Bower and Christensen in 1995[2] to refer to a type of technology that brings about a sudden change to established technologies and markets. Because these technologies are characteristically hard to predict and occur infrequently, they are difficult to identify or foresee.

distribution analysis A statistical method of analysis that can be used to describe the relationship between items in a data set, or to predict the probability of future occurrence of a data point.

enabler Technology that makes possible one or more technologies, processes, or applications.

exceptions analysis A method of analysis that uses algorithms to determine when a data point goes beyond a "normal" threshold.

expert sourcing Working with a specialized group of experts to solve a problem.

extrapolation The use of techniques such as trend analyses and learning curves to generate forecasts.

gear down Using archaic technologies to solve current problems.

gear up Applying scientific advances to create advanced technology to solve problems.

innovation The creation of a new device or process as a result of study and/or experimentation.

long bet See *accountable prediction.*

mash, mashup A Web page or application that combines data or functionality from two or more external sources to create a new service.[3]

measurement of interest A key characteristic or indicator that can be monitored to anticipate the development of disruptive technologies and applications. A measurement of interest could have a threshold (e.g., energy stored per unit of mass, price per gallon of gasoline) that, once crossed, triggers other significant occurrences. Such a threshold on a measurement of interest could provide a *signal* or *signpost.*

mining See *data mining*.

narrative A story or an account of events or experiences, either true or fictitious. In a forecast, a narrative can provide a context within which a specific prediction takes on broader significance.

persistent forecast A forecast that is continually improved as new methodologies, techniques, or data become available.

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[2]Joseph L. Bower and Clayton M. Christensen. 1995. Disruptive technologies: Catching the wave. *Harvard Business Review*. January-February.

[3]From http://en.wikipedia.org/wiki/Mashup_(web_application_hybrid). Last accessed November 17, 2009.

prediction market A market created for the purpose of making predictions on future events (e.g., presidential elections).

roadmapping A time-honored technique for forecasting technological advances. It is most useful for forecasting raw technical capabilities, not for forecasting the applications enabled by technologies.

scenario See also *vision*. An imagined or projected sequence of events. Scenarios can be used as tools for understanding the complex interaction of forces that influence future events.

signal A piece of data, a sign, or an event that is relevant to the identification of a potentially *disruptive technology:* for example, Apple, Inc., placing a large order for new touch capacitance screens from a Chinese supplier.

signpost A recognizable and actionable potential future event that could indicate an upcoming disruption. "Recognizable" means that reasonable people would agree on whether the event has happened. "Actionable" means that the event is sufficiently important to require an organizational decision and response.

technology forecasting system Technologies, people, and processes assembled to minimize surprise triggered by emerging or disruptive technologies, in order to support decision making.

tipping point The time at which the momentum for change becomes unstoppable.

trend extrapolation A forecasting method in which data sets are analyzed to identify trends that can provide predictive capability.

viral Pertaining to the rapid spread or distribution of an idea from one to many.

vision A forecast of a potential future state of reality described in a vague way: for example, passenger vehicles powered primarily by energy sources other than the gasoline-powered internal combustion engine. See also *scenario.*

Web crawling or spidering A process in which a computer program methodically searches the Internet for specific types of data.

Web scraping A computer software technique of extracting information from Web sites.[4]

wiki A community-accessible Web site with a user-friendly graphic user interface that can be used for collaborative work on documents.

[4]For more information, see http://www.extractingdata.com/web%20scraping.htm. Last accessed January 28, 2010.

Summary

Formalized technology forecasting dates back to the years immediately following World War II when the RAND Corporation developed the Delphi method, a structured process for eliciting collective expert opinions about technology trends and their impact (Dalkey, 1967). Gaming and scenario planning also emerged as important technology forecasting methods in the 1950s and experienced a dramatic increase in popularity during the 1970s. All of these methods as well as other quantitatively oriented methods such as extrapolation and trend analysis are in use today. All forecasting methods depend to some degree on the inspection of historical data. However, an exclusive reliance on historical data inevitably leads to an overemphasis on evolutionary views of innovation and leaves the user vulnerable to surprise from rapid or nonlinear developments.

Technology forecasts are widely used by governments, corporations, financial institutions, and the investment community. A useful forecast provides insights on potential future outcomes that lead to effective action in the present. A forecast of disruptive technologies is designed to reduce surprise by alerting decision makers and providing them with the tools needed to avoid unanticipated and perhaps catastrophic outcomes. It should supply decision makers with a range of possible alternative futures to assist them in allocating resources and making informed decisions.

One way that a forecast can support decision making is by providing a technological roadmap that can be used for tracking and planning and that alerts users to significant changes in the likelihood of a predicted scenario. A useful forecast must provide insight into the possible, not just the probable. Likewise, forecasts should be evaluated on their ability to capture high-impact, disruptive outcomes rather than on the ratio of correct-to-incorrect predictions that they make.

This committee's first report studied the value of using forecasting methods that solicit input from the general public (NRC, 2010). The goal of soliciting public participation, or crowdsourcing, in a forecasting system is to cast a wide net that gathers a multitude of forecasts, signals, and opinions. This is especially important as technology innovation becomes more diverse and geographically diffuse in its approaches and as regional variations of technology applications flourish. Collaboration technologies, especially those that leverage the power of the Internet, can be used to discover expertise in unexpected places.

Experts are typically better than novices are at judging the importance of new signals in an existing forecasting system (Enis, 1995). In the technology forecasting platforms examined in the committee's first report (X2, TechCast, and Deltascan), it was found that experts generally create high-signal and low-noise forecasts. However, other research (Önkal et al., 2003) suggests that experts are not necessarily better than the public at making forecasts.

Experts may not catch the full range of alternative solutions from fields outside their areas of expertise or from the reapplication of technologies developed to solve a different problem. Paradoxically, the specificity of knowledge required to achieve expert status can invalidate forecasts generated by experts alone (Johnston, 2003).

DISTRUPTIVE TECHNOLOGIES

The term "disruptive technology" describes a technology that results in a sudden change affecting already-established technologies or markets (Bower and Christensen, 1995). Disruptive technologies can be defined beyond Christensen's market-based conception as technologies and applications of technologies that can significantly influence the balance of global power. Disruptive technologies cause one or more discontinuities in the normal evolutionary life cycle of technology. This may lead to an unexpected destabilization of an older technology order and an opportunity for new competitors to displace incumbents. Frequently cited examples include digital photography and desktop publishing, as well as older innovations such as the automobile and the telephone.

Other disruptions can be caused by "reverse innovations" that can bring well-established technologies to markets and societies that previously did not have access to these technologies or could not afford them (Govindarajan, 2009). These innovations could be the result of breakthroughs in pricing, accessibility, distribution, business models, manufacturing, research and development (R&D), resource use, or ease of use. Many of these innovations are built around what has been labeled the Gandhian engineering concept of more (social value) from less (low technology, resources use, and cost) for more (dissemination) (Giridharadas, 2008). For disruption to take place, many of these innovations rely not just on low cost and affordability, but also on distribution to developing countries. Emerging markets can be sources of disruptive innovations (Bhan, 2010). Tata's Nano, the One Laptop Per Child computer, and India's AirTel are notable examples.

Disruptive technologies can impact society both positively and negatively. The nature of such impacts is greatly dependent on an individual's point of view—a disruption that is harmful to some will benefit others. Given the ability of disruptive technologies to dramatically alter a competitive environment, displace incumbents, and impact society, there is a great need for technology forecasts (1) to help identify potentially disruptive technologies and (2) to contribute to the understanding of their potential disruptive effects. These two forecasting outputs are fundamental to producing a useful forecast.

This report is the second of two reports produced under the auspices of the National Research Council's (NRC's) Committee on Forecasting Future Disruptive Technologies, sponsored by the Office of the Director of Defense Research and Engineering (DDR&E) and the Defense Warning Office (DWO) of the Defense Intelligence Agency (DIA). This committee was established at the request of the sponsoring organizations to provide guidance on how to conduct long-term forecasting of disruptive technologies. The statement of task for the study is provided in Box S-1.

In its first report, *Persistent Forecasting of Disruptive Technologies*, the committee discussed how technology forecasts were historically made, assessed various existing forecasting systems, and identified desirable attributes of a next-generation persistent long-term forecasting system for disruptive technologies (NRC, 2010). In this, the second report, the committee was asked to attempt to sketch out high-level forecasting system designs that could satisfy the key design criteria of the forecasting system concept developed in the first report. The sponsor also sought further evaluation of the system attributes defined in the first report, and evidence of the feasibility of creating a system with those attributes. Together, the reports are intended to help the Department of Defense (DoD) and the intelligence community (IC) identify and develop a forecasting system that will assist in detecting and tracking global technology trends, producing persistent long-term forecasts of disruptive technologies, and characterizing their potential impact on future U.S. warfighting and homeland defense capabilities.

The committee identified three broadly defined goals for addressing its statement of task: to develop further the structural framework for how to approach the problem of developing a long-term persistent forecast of disruptive technologies, to create alternative models of what such a system might look like, and to define actionable steps toward development. To meet these goals, the committee held a one-day workshop with invited experts from related fields (see Appendix C for a list of participants), followed by a one-day closed meeting to analyze the

BOX S-1
Statement of Task

The committee shall conduct a workshop to provide expert insight in designing a persistent forecasting system.* The committee will invite expert forecasters and users of forecasting systems, including:

- Experts from a variety of industries (i.e., technology, energy, finance)
- Regional experts with knowledge of Asia, Europe, the Middle East, and the Americas
- Representatives of the United States Government and foreign governments

The workshop will focus on the development of one or more conceptual high-level diagrams of a process that could be used to produce persistent forecasts of disruptive technologies. The final report will include transcripts of the workshop and copies of visualizations created during the workshop. The committee will comment on the insights gained from past committee meetings and the workshop and recommend options for future courses of action in the development of a persistent technology forecasting system.

* "Technology forecasting system" was defined in report 1 (NRC, 2010, p. xvi) as follows: "Technologies, people, and processes assembled to minimize surprise triggered by emerging or disruptive technologies, in order to support decision making."

input from the workshop and previous committee meetings. This report reflects the information received during both phases of the study.

To gain practical information, the committee defined the following objectives for the workshop:

- Develop one or more high-level designs of potential approaches to a prototype version[1] of the system.
- Gain insights on how to approach the development of the system.
- Estimate a gross level of effort to launch such a system.
- Document the key insights from the sessions and workshop that could provide guidance for the development of the system.

In the first part of the workshop, several key observations made by presenters and participants helped frame the need for and challenges of a persistent disruptive forecasting system:

1. War in the future may be very different from war as it is waged today. It may not involve the use of deadly force, or in the words of Committee Chair Gilman G. Louie, "things that go boom!"
2. New applications of technologies are hard to predict, and the pace at which new applications are being developed and adopted globally is ever faster.
3. The United States is not the sole creator, keeper, and distributor of high-quality technologies that have disruptive impact.
4. The world is "lumpy": technologies impact different people and cultures differently. In different countries, different technology clusters have different priorities.
5. In many cases, it is more important to understand the impact of a technology than to understand the technology itself.

[1]The committee believed that it would be better to pursue a basic functioning 1.0 system than a prototype. (A 1.0 system is a minimal working system with basic core functions that is used by its target users as a production system. Prototypes are typically testbeds that are used to validate an approach with a small number of users and that have a subset of the required core functions.)

6. Many disruptive technologies are the result of new applications, or combinations of developed and well-understood technologies.
7. It is not just about high-tech. Low-tech innovations can have an even greater disruptive effect than advanced ones do, especially in developing countries.
8. A disruptive forecast cannot rely solely on expert advice. It is necessary to ask those who are most likely to be directly affected by future disruptive changes.
9. Technology lists produced by forecasts have limited value. Secondary effects also need to be explored.
10. Technology forecasts typically provide a snapshot of current thinking and are quickly obviated by new data and events.
11. To be of optimum value, a disruptive technology forecasting system must serve needs beyond those of the DoD and must be useful to other entities, including other countries.

Based on these observations and its prior work, and given the speed and quantity of today's data flows, the committee became convinced that a system for forecasting low-probability, high-impact innovations must have a specific set of characteristics that differentiate it from most past forecasting methodologies: it must be persistent, open, and failure-tolerant and must operate in multilingual domains.[2] Instead of making discrete predictions, it should include roadmaps that track the development of events as they occur.

Persistence

To detect emerging trends, a successful disruptive technology forecasting system must continuously update and improve forecasts as new data become available. In this persistent system, the historical development of a forecast can be tracked and analyzed, creating valuable insights that can be used to improve later forecasts. This type of dynamic and responsive platform is attractive to many communities of users, giving it a more robust base of data and increasing its overall utility.

The outcomes of a persistent system differ from those of many traditional methods of forecasting in the following ways:

- The forecasts of the persistent system are current and based on the best knowledge available as they advance.
- The system's data archives can be used as a repository for other forecasts. Currently, there is no single place within the DoD, much less the U.S. government, where technology forecasts from multiple agencies can be seen and referenced.
- A persistent data-gathering platform can be incorporated into multiple programs and applications.
- Rather than having a forecasting cycle, a persistent system allows forecasts to be generated or updated continuously as new signals appear.
- As new technologies, communities, or applications evolve, they can be integrated into the system and applied to existing work.
- As the historic base of data grows, this archive becomes a valuable resource with which to test and refine new forecasting tools and methods using backcasting.

Openness and Crowdsourcing

Internet technology spreads knowledge virally, distributing it worldwide to people of all ages and cultural backgrounds. Technological change can come from unconventional and nontraditional sectors. Attendees at the workshop and the committee believe that input from a broad range of participants is key to tapping into far-flung

[2]For the Department of Defense version of the forecasting system, the DoD might consider leveraging the DNI [Director of National Intelligence] Open Source Center capability in the Science and Technology and Translation Production environment.

signals indicating technology change. Crowdsourcing is "the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call" (Whitford, 2008). The definition was initially discussed by Howe (2006). A crowdsourced forecasting system harnesses the creative ability and diversity of different global populations to develop the widest possible range of scenarios and potential future narratives. Ideas can be drawn directly from the crowd using established Web-based models such as participatory special-interest-community Web sites, predictive market tools, and interactive gaming. Crowdsourcing can also be used indirectly: sophisticated Web-based search algorithms can extract data of interest from such sources as blogs, professional association Web sites, competitions, or published literature.

Classical approaches and sources for forecasting, such as brainstorming by experts, market surveys, searches of published papers, and classic data collection can be combined with data obtained through crowdsourcing to create a richer base of knowledge. This could significantly improve the chances of discovering disruptive indicators before the disruptive technology emerges. Although forecasts that involve classified, proprietary, or private data cannot be crowdsourced and made public, the analysis of sensitive data can be run parallel to the process that uses crowdsourced data.

Creativity and Tolerance for Failure

The unexpected application of existing and well-understood technologies can, in many cases, cause the greatest surprise and disruption. Often, surprise is not caused by a single new technology but by the application of a new technology in conjunction with an existing technology, or by a novel application of an old technology. Uncovering the connections between new technologies, old technologies, and current human needs requires a willingness to explore "crazy" ideas. Creative minds are needed to tease out useful information and find patterns among disparate sets of data. In a persistent system, the meaning of these patterns can be reinterpreted, in the light of earlier work, as new signals emerge. During this process, scenarios that initially seemed highly unlikely might emerge as relevant.

A forecasting system for disruptive technologies must tolerate failed forecasts. By nature, a disruptive technology will be difficult to predict, and so most predictions will not be realized. Rather than predicting the occurrence of a specific innovation, a good forecast predicts the problems that will be solved with technology and the effects of different possible solutions. Given the multitude of possible technological solutions to a single problem, predicting effects is an effective way to limit surprise and to measure the success of a forecast.

Risk Management

The integrity of a forecasting system should be protected through multiple stages of development and operation. Specific areas of risk that should be addressed include technology and engineering risk, data risk, security vulnerabilities risks, leadership and personnel risk, disruptive idea risk, user risk, financial risk, and stakeholder risk. Each of these risks should be considered and mitigated during the design and implementation of a persistent forecasting system, as discussed in Chapter 1.

Predictions Versus Roadmaps

A list of emerging technologies provides little basis for prioritizing their disruptive potential impact or allocating resources to the most threatening scenarios, especially if those scenarios are seen as low-probability outcomes. A set of potential future roadmaps provides the necessary insight to enable better preparation for the unexpected. A useful forecast will lay out several roadmaps of potential futures, with indicators and parameters that can be used to follow the progression of events and evaluate the likelihood of each scenario's coming true. It should include the cultural, social, and environmental signals and signposts that might indicate a disruptive scenario.

MODEL DESIGN OPTIONS DEVELOPED AT THE WORKSHOP

The workshop began with a group discussion of system goals and design features, followed by a moderated system design exercise. The workshop participants were divided into three small subgroups to facilitate participation by all group members. Each subgroup developed an option for system design, and a fourth option was submitted by workshop attendee Stan Vonog. The four options were labeled by the committee as follows:

1. Intelligence Cycle Option
2. Roadmapping Option
3. Crowdsourced Option
4. Storytelling Option

Intelligence Cycle Option

The name Intelligence Cycle Option was given to the system design that uses an approach similar to the classic approach used by the intelligence community: hypothesize, task, collect, and analyze. This system design is organized around four functions:

1. The input of a "big question,"
2. Signal identification and hypothesis generation,
3. Hypothesis evaluation and testing, and
4. The authoring of potential future narratives.

The initial system input is a "high-level question" framed by the stakeholder, which is then used to initiate creative hypothesis generation fed by passive data collection (from movies, media, and online databases, for example) and active data-gathering (e.g., crowdsourcing, games). The hypotheses undergo evaluation by experts or outside participants in the science and technology, financial, and sociopolitical arenas or through data analysis or mechanisms such as games (by which scenarios can be tested) or focus groups. The output from these processes is shaped into a complete narrative of possible events and presented to stakeholders. It can then be used as input for further hypothesis development and analysis.

Roadmapping Option

The Roadmapping Option for system design focuses on developing roadmaps of predicted events proceeding from the present to predicted future scenarios. The roadmaps are based on collected data, including observations of communities of interest. The key to this model is the generation of signposts that can be monitored as the roadmap progresses. The major elements of the system are as follows:

1. Idea generation;
2. Techniques for mapping, processing, and evaluating inputs; and
3. Communication to decision makers.

This design starts with the selection of existing communities that are in the process of experimenting to solve problems. The subgroup decided that for the 1.0 version, a limited number of communities of interest should be monitored in order to gain an understanding of their activities. These communities of interest should have considerable activity and resources—both human and capital—behind them.

Ideas collected from these communities plus other traditional data-gathering techniques are employed to develop future scenarios to be explored. Knowledge-discovery tools such as data mining, classifiers, and data-visualization tools can be used to assist forecasters in monitoring various communities of interest. The ideas generated by these communities then need to be filtered and spun into narratives. The predictions or hypotheses generated from the narratives are correlated with current events, mapped to current trends and models, and explored by different communities to test their validity. Refined hypotheses or narratives are analyzed to determine the impacts of and paths to their realization. Experts backcast by predicting, based on a forecasted future event, a roadmap of how that event might occur, including the signposts and signals that would indicate progress. The forecasting system then searches for the identified signposts and signals. As data accumulate and correspond to the narratives, some will emerge as more relevant than others. Ultimately, the signals, signs, and scenarios and their impacts are reported to decision makers.

Crowdsourced Option

The Crowdsourced Option forecasting system is organized by input, analytical approaches, and outputs, with a focus on creating clear, actionable outputs in the form of reports. Its name reflects its use of open participation from the "crowd" (either the general public or targeted populations) to gather forecasting inputs. These inputs are analyzed in multiple ways, employing a combination of crowdsourcing techniques and expert analysis. The final analysis is done by an expert forecasting committee or their delegates. If this endeavor were conceptualized as a business, the expert forecasting committee would be the founding board. That committee, or its delegates, would respond to a specific query from a stakeholder or a sponsor. It would then be the responsibility of the expert forecasting committee to produce regular, systematic reports. Reports can also be made on interesting signals, events, or technologies that are independent of a customer query.

The public face of this crowdsourced option would be "Disruptipedia," an online portal where data, information, live questions and responses, signals, signposts, forecasts, scenarios, and narratives would be displayed. To attract contributions from smart, observant, knowledgeable people, incentives could include real or virtual currency or the attention of influential people. The input could have an alternate use that would be beneficial to creative people—as a source for movie script ideas, for example. Such an arrangement could therefore be mutually beneficial to the forecasting committee members and the participants. Disruptipedia would serve as a living repository for the gathered information, so that consistent data, information, and language could be accessed through the decades as the system grew.

Storytelling Option

One final option, suggested by an individual workshop attendee, was inspired by attendee comments that forecasts should be contextualized by forming associated narratives of possible future events. The system is derived from a functional organization chart released by Walt Disney Studios in 1943 and is based on the storyboard process—bringing a story idea through production to the screen. The model focuses on the development of narratives from broad themes or "big questions." Using this question as a central theme, a small set of potential scenarios is created that identify possible contexts for exploration. Data relevant to those potential scenarios are then collected using both human- and machine-based methods. Next, the data undergo critical analysis by teams of scientific, technical, and political and economic experts who identify trends and form viable hypotheses, all of which are reported back to a story director. These hypotheses are applied to the initial scenarios to create output in the form of complete narratives that can be used in reports, demonstrations, and entertainment media. Notably, the Disney model incorporates no hierarchy that breaks operating divisions into separate "silos." The chart lacks chain of command and authority. Instead, all staff positions serve to support a common work flow.

KEY OBSERVATIONS AND RECOMMENDATIONS

After the workshop, the committee met and discussed the data collected at previous meetings and the output from the workshop exercises. After considering the sum of collected ideas from these activities, the committee made the following key observations and recommendations for future courses of action in the development of a persistent technology forecasting system. Additional observations and recommendations are offered in Chapters 1 through 3.

Flexibility and Leadership

The model-building exercise performed at the Forecasting Future Disruptive Technologies Workshop convinced the committee that there are multiple viable approaches to building a persistent forecasting system. Given the multitude of design options available, the committee believes that building a minimal but functioning system (hereafter referred to as a 1.0 system) to test and develop would be a more productive next step than to spend excessive resources on planning a complete system structure at the outset. A 1.0 system should embody six important functions: (1) needs definition, (2) collecting alternative futures, (3) developing alternative futures, (4) roadmapping, (5) engagement, (6) and feedback. Each option produced at the workshop contained at least one particularly well-thought-out element that merits special consideration.

Key Observation. The Department of Defense needs one or more effective forecasting systems of disruptive technologies to reduce surprise created by future disruptive technologies.

Key Observation. There is more than one way to build a forecasting system; each model has different strengths and weaknesses.

Key Recommendation. The 1.0 version of a forecasting system should employ the extensive passive and active data-gathering techniques employed in the Intelligence Cycle Option, using the data to develop roadmaps of potential futures with signals and signposts derived from data inputs (as seen in the Roadmapping Option). The end product of the system should include constant output and objective-driven output as described in the Crowdsourced Option. (Recommendation 2-1)

Key Observation. The illustrative models developed at the workshop indicate that the design and building of a 1.0 version persistent forecasting system for disruptive technologies are possible using existing technologies and forecasting methods and can be achieved within a reasonable time frame using a modest level of human and financial resources.

Key Observation. A disruptive technology forecasting system focuses on technological wildcards: innovations that have a low or unknown probability of development but, if developed, would have enormous impact.

Key Recommendation. A persistent disruptive forecasting system should be built to help the intelligence community reduce the risk of being blindsided by disruptive technologies. (Recommendation 3-9)

Narrative Focus

Another major concept reinforced by the workshop is the importance of a focus on developing narratives of the human use and impact of technology instead of a focus on specific technologies. It is the context of solving human needs that drives technology use. The forecasting system should therefore start by identifying big problems and opportunities and using them to generate alternative scenarios and hypotheses from which relevant technologies can be derived. There are often multiple solution paths to solve a single problem, but the immediate and second-order effects of the different solutions might be very similar. Scenarios will also vary by region, as they will have distinct impacts and solutions in different locales. To improve the robustness of the scenarios, it is important that there be regional representation in the creation of these scenarios and the development of the narratives. By emphasizing the narrative, forecasters avoid devoting too many resources to tracking “the wrong” solutions and technologies and instead stay focused on the potential effects of disruptive technologies. They also create compelling arguments that can later be presented to stakeholders.

Narrative is a useful and powerful tool that can augment and contextualize other forecasting tools and approaches. Both quantitative and qualitative forecasting approaches have a role in a robust forecasting system. Many of these approaches, discussed in detail in this committee’s first report (NRC, 2010), can and should be integrated into the various model design options. The workshop participants and committee members focused on the importance of including the use of narrative to contextualize the impact of forecasted technologies and alternative futures derived from both qualitative and quantitative forecasting methods.

Key Observation. Beginning the forecasting process with narratives of potential futures rather than starting with a list of potential technologies produces more useful insights into possible outcomes.

Key Recommendation. The 1.0 version of a forecasting system should begin developing a forecast of future events or conditions by constructing structured narratives describing disruptive impacts within a specific contextual framework related to particular technology use. It should then use backcasting to roadmap potentially disruptive technologies and the triggers that enable these technologies, and then iterate the mileposts for the narrative. (Recommendation 3-1)

Key Recommendation. The responsible organization should develop a repository of narratives of potential futures, organized both globally and by region, that include potential economic, technological, and societal impacts. (Recommendation 3-2)

An internal DoD team will need to address the challenges of handling classified and compartmentalized data and scenarios, and create appropriate processes for including them in a repository.

Role of Government

The workshop attendees and committee members believe that a large portion of the forecasting system should be independent of the government in order to attract contributions of data from diverse sources and to maximize opportunities to collect innovative input. To generate data representing the widest possible variety of ages, regions, ethnicities, and points of view, the system should be open to the general public. An obvious U.S. government affiliation might deter participation, leading to biased forecasts. Therefore, the resources and talent for the design, building, and retaining of the system should come primarily from outside the government.

Key Recommendation. Any forecasting system developed should be insulated to allow users to generate and investigate controversial or uncomfortable ideas. Participants and staff should identify the reasons that an idea is considered implausible and be able to understand what developments will be needed to arrive at that future. These developments should become signposts on the roadmap of the forecast. (Recommendation 3-4)

Key Recommendation. The Department of Defense and the intelligence community should consider using a separate, independent, multinational, multidisciplinary nonprofit or dot-org group to run the crowdsourced platform. The organization should be structured correctly from the beginning to ensure trust and good working relationships among staff. The crowdsourced platform should have its own separate governance with leadership representing multiple ethnicities and disciplines. (Recommendation 3-7)

Key Recommendation. A forecasting system should have two separate teams, one team working on the open external forecasting platform and another team developing an internal forecasting platform that services specific needs of an organization. The external team should encourage broad and open participation and exchange of ideas and scenarios from a broad range of participants and experts. The internal forecasting platform should address scenarios that are specific to the organization and may involve sensitive, proprietary, or classified scenarios and data that it is only willing to share with trusted parties. (Recommendation 3-8)

Funding and Management

The workshop attendees and committee believe that the forecasting system should be built and funded according to a start-up model, whereby the government provides seed-level financing to build a working 1.0 version of the system. Beginning the project with minimal resources forces the development team to make tough decisions up front and to focus the effort on developing and perfecting core system features. The leaders in charge of the system should be forced to seek additional outside funding sources, ensuring that the system is robust enough in its early stages to inspire confidence and attract sponsorship. Once developed, the system needs to be able to sustain itself by providing enough ongoing value to attract continual sponsorship from both government and other parties (including governments, corporations, institutions, and organizations) to cover the cost of operating, maintaining, and improving the system.

Key Recommendation. The Department of Defense and the intelligence community should begin the process of building a persistent forecasting system by selecting leadership and a small, independent, development team. The team should be given seed-level funding to establish an organizational structure and business plan and build a working 1.0 version of a disruptive technology forecasting system. The organization should have to attract additional funds from domestic and foreign corporate, nonprofit, or government sources. (Recommendation 3-6)

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1

Introduction

The best way to predict the future is to invent it.
—Alan Kay

STUDY OVERVIEW

This report is the second of two National Research Council (NRC) reports that investigate how the Department of Defense (DoD) can use long-term forecasting to reduce the type of surprise that can be caused by high-impact technologies. Both reports were prepared by the NRC's Committee on Forecasting Future Disruptive Technologies, whose efforts were sponsored by the Office of the Director of Defense Research and Engineering (DDR&E) and the Defense Warning Office (DWO) of the Defense Intelligence Agency (DIA).

The first report, *Persistent Forecasting of Disruptive Technologies*, describes existing forecasting methodologies and critiques the latest, most innovative attempts to build comprehensive forecasting systems (NRC, 2010). It also discusses disruptive technologies as a source of surprise and suggests design features that should be incorporated into a next-generation forecasting system for disruptive technologies so that better predictions can be made of innovations arising from nontraditional sectors.

For this report, the committee was asked to outline one or more conceptual models that could be used to build a forecasting system for disruptive technologies based on the design features identified in the first report. The sponsor also requested that the committee provide evidence of the feasibility of creating the proposed system and that it recommend options for proceeding. These two reports are intended to help the DoD and the intelligence community (IC) develop a forecasting system that will assist in detecting and tracking global technology trends, producing persistent long-term forecasts of disruptive technologies, and characterizing their potential impact on future U.S. warfighting capabilities. The statement of task for this second report is given in Box 1-1.

To meet the goals of the statement of task for this second report, the committee met in San Francisco on November 5 and 6, 2009. On November 5, the committee convened the Forecasting Future Disruptive Technologies Workshop, a 1-day workshop at which it was joined by a panel of invited experts in related fields (see Appendix C for a complete list of workshop participants). On November 6, the committee held a closed meeting to develop the basis of this report, using outputs and comments from the workshop in addition to data and insights collected in all previous committee meetings (meeting dates and presentations are listed in Appendix B). This report reflects the information received during both phases of the study.

From the 1-day workshop and the previous committee meetings, the committee had three broadly defined goals: (1) to develop further the structural framework for how to think about the problem of developing a long-term persistent forecast of disruptive technologies, (2) to create alternative models of what such a system might look

BOX 1-1
Statement of Task

The committee shall conduct a workshop to provide expert insight in designing a persistent forecasting system.* The committee will invite expert forecasters and users of forecasting systems, including:

- Experts from a variety of industries (i.e., technology, energy, finance)
- Regional experts with knowledge of Asia, Europe, the Middle East, and the Americas
- Representatives of the United States Government and foreign governments

The workshop will focus on the development of one or more conceptual high-level diagrams of a process that could be used to produce persistent forecasts of disruptive technologies. The final report will include transcripts of the workshop and copies of visualizations created during the workshop. The committee will comment on the insights gained from past committee meetings and the workshop and recommend options for future courses of action in the development of a persistent technology forecasting system.

* "Technology forecasting system" was defined in report 1 (NRC, 2010, p. xvi) as follows: "Technologies, people, and processes assembled to minimize surprise triggered by emerging or disruptive technologies, in order to support decision making."

like, and (3) to define actionable steps toward the development of such a system. Specifically, the committee's objectives for the workshop were the following:

- Develop one or more high-level designs of potential approaches to a 1.0 version of the system.
- Gain insights on how to approach the development of the system.
- Estimate a gross level of effort for launching such a system.
- Document the key insights from the sessions and workshop that could provide guidance for the development of the system.

REPORT STRUCTURE

The present report uses multiple methodologies to approach the development of a version 1.0 system of a forecasting system model that specifically addresses the needs of the defense intelligence community. The sections below in this chapter introduce the context and bridge from the committee's work in its first report (NRC, 2010) on traditional forecasting processes to forecasting systems as conceived by the committee. Chapter 2 describes the results of experiments undertaken by three subgroups of the workshop to actually design forecasting systems that would meet the design criteria explored by the committee; the chapter also outlines a fourth system—a storytelling model suggested by an individual workshop participant. Chapter 3 evaluates and synthesizes the results of the experiments, describes the characteristics of a system that integrates the best attributes of the four design options, and recommends the next steps toward the development of the system. Appendix A contains biographical sketches of the members of the committee. Appendix B lists the presentations delivered to the committee throughout this project. Appendix C lists the experts who participated in the November 5 workshop. Appendixes D and E (on the CD enclosed with this report) provide the unedited transcripts of the workshop, and Appendix F presents graphics created as visualizations of the main ideas produced in the workshop. Because of the volume of the material they contain, Appendixes D and E do not appear in print form.

DEFINING "DISRUPTIVE TECHNOLOGIES"

As described in the first (NRC, 2010) report, the word "disruptive" connotes an interruption or upset to the orderly progression of an event, process, or activity, or a break in service. The word can also imply confusion or disorder, or a drastic alteration in structure. A disruptive technology is an innovative (although not necessarily new) technology that triggers sudden and unexpected effects. Disruptive technologies can have both negative and positive consequences. A disruptive technology can be an enabler (such as the automobile), can pose a threat (e.g., improvised explosive devices, or IEDs), or can have elements of both (e.g., the Internet). By contrast, "emerging technologies," those that are currently gaining prominence or importance, may become disruptive early or late in their life span, or in a region far from their origin, or they may not become disruptive at all. Often, the potential disruptive impacts of a technology are not initially obvious but become evident in hindsight. For the development of this second report, Committee Chair Gilman G. Louie explained to workshop participants that a disruptive technology is characteristically hard to predict and by nature occurs infrequently, so it might be difficult to identify or foresee. Such a technology can cause an abrupt, revolutionary change to established technologies and markets; and while perhaps starting locally, it may significantly alter the balance of global power (in financial, military, security, trade, and scientific realms).

PITFALLS IN FORECASTING

Why do disruptions happen and how can they be predicted? Looking at past events caused by disruptive innovations—the attacks of September 11 or at Pearl Harbor, for example—it is immediately obvious that useful data were available that, if acted on, might have averted those surprise attacks. The analysis of disruptive events after the fact shows that the information necessary to predict the event was missed for a variety of reasons, including the following:

- Not knowing enough to ask the right question,
- Asking the right question but at the wrong time,
- Assuming that the past is an indication of the future,
- Mirroring (assuming that one's beliefs are held by others),
- Not having enough pieces of the puzzle to put together the whole picture because of information fragmentation,
- Not being able to distinguish good from bad information amidst the noise of information overload,
- Biases (institutional, communal, personal, etc.) in data evaluation, and
- Lack of vision.

A NEED FOR ENHANCED FORECASTING OF DISRUPTIVE TECHNOLOGIES

Importance of Forecasting to the Department of Defense

The use of technological surprise was identified in the 2006 Quadrennial Defense Review (QDR) as one of four potential threat strategies that could challenge U.S. military capability. Forecasting disruptive technologies or events is important to the DoD for three reasons, as laid out by Alan Shaffer, director of Plans and Programs, DDR&E (Shaffer, 2005). First, in both corporate and military environments, staying current on technologies and anticipating potential disruptive influences are vital to staying competitive. Second, until recently, the United States minimized surprise by protecting its advanced-technology secrets. As other countries and non-state actors become more technologically sophisticated—as purchasers of commoditized technology or as developers or both—the United States can no longer assume technological leadership in every area of technology development or application that might be used for military purposes. In the new paradigm, the military needs to stay abreast of new technologies as well as of new applications being developed throughout the world in order to avoid military surprise. Third, although many believe that the United States does well at keeping abreast of big-platform and dedicated military technologies, it can still be surprised by the application of commercially and publicly available technologies to create unanticipated disruptive military applications. The pervasiveness and effectiveness of IED attacks against the U.S. military in Iraq and the use of commercial airliners by terrorists against the U.S. homeland are examples of how applications of readily available commercial technologies can be used as highly disruptive military weapons and can surprise military planners.

Additionally, the DoD could use information obtained from forecasting activities to leverage emerging trends and to create asymmetric advantages for the United States. Disruptive technology forecasting need not be a purely defensive exercise.

A high-level disruptive technology forecasting system could be used by the DoD in the following ways:

- To increase the lead time for stakeholders to plan and address potential disruptions;
- To provide early indications of potential emerging new and disruptive technologies, and
- To provide stakeholders with tools for prioritizing potential threats and allocating resources to increase the ability to capitalize on, protect against, or mitigate the impact of a potential disruption.

Observation. The Department of Defense needs one or more effective forecasting systems of disruptive technologies to reduce surprise created by future disruptive technologies.

An effective forecasting platform could help the DoD to better prepare for potential disruptive technologies and enable it to develop proactively the preparatory strategies for countering the negative effects of disruption. Given the typically long development cycle for counter-disruptive technologies in the United States and the capability and speed of some U.S. adversaries in developing new disruptive technologies, particularly those that leverage commercial technologies, the United States cannot afford to rely on a reactive strategy. It must proactively prepare for potentially highly disruptive technologies.

Technology and Disruption in the 21st Century

It is believed by many forecasters and technologists that at this historical moment the risk of global disruption is greater than ever before. According to Irving Wladawsky-Berger (2008) of the IBM Academy of Technology at a presentation to the committee:

> There are a set of forces converging on organizations today—both business forces and technical possibilities—that are driving different choices about business designs and the underlying computing infrastructures. Those forces aren't new. But in a networked world that's always on, you feel these pressures more acutely and in real time. Because of the global marketplace and the Net, every institution has far greater contact with the world—access to more markets and information, exposure to more threats, and a rapid fire competitive environment. Those companies that lead their industries are the ones best able to adapt and build the right partnerships at this intersection of business and technology.

Experts in other disciplines agree. Ray Kurzweil, whom Bill Gates called "the best person I know at predicting the future of artificial intelligence," proposes in *The Singularity Is Near: When Humans Transcend Biology* that the pace of change of technology "is exponential (that is, it expands by repeatedly *multiplying* by a constant) rather than linear (that is, expanding by repeatedly *adding* a constant)" (Hodgkinson, 2009; Kurzweil, 2005). See Figure 1-1. He postulates that at some point a "technological singularity" will occur where the level of human technology will become infinite or extremely high and artificially enhanced human/computer intelligence will synergistically transcend human biological intelligence. His description of the disruptive power of this technological synergy is very apt for disruptive technologies in general: "Exponential growth is deceptive. It starts out almost imperceptibly and then explodes with unexpected fury—unexpected, that is, if one does not take care to follow its trajectory" (Kurzweil, 2005, p. 8). Kurzweil's vision for the future is valuable not so much for its accuracy as for its insight into the disruptive potential of technological confluences. While the principle of exponential growth does not have universal validity, it does have important application in technology forecasting.

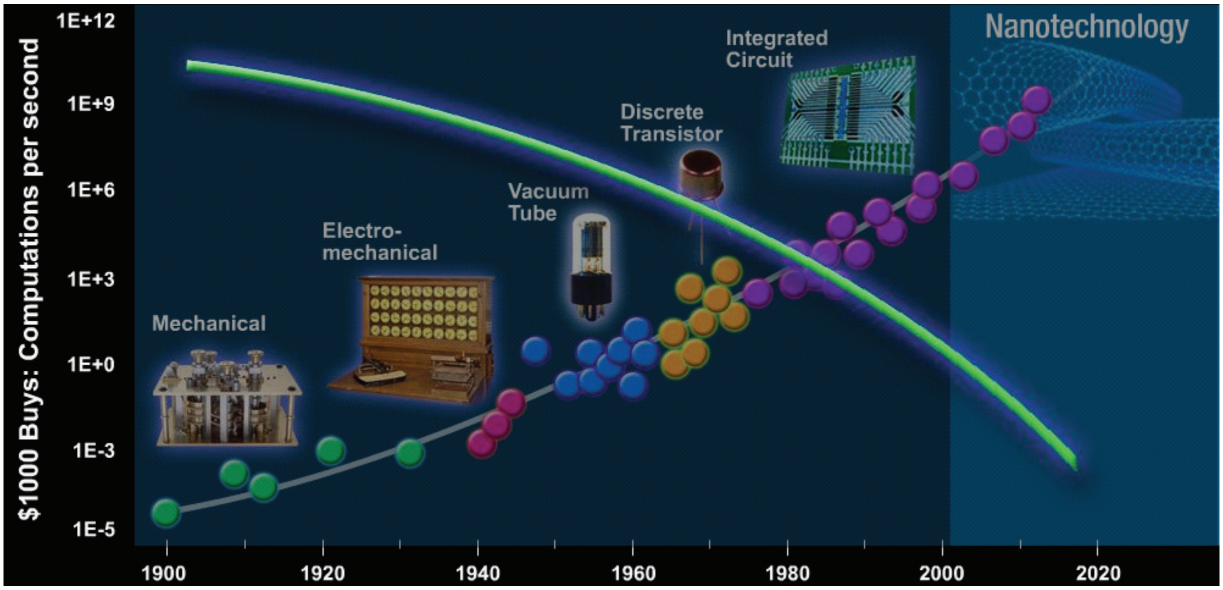

FIGURE 1-1 The exponential advance of information technology. In 1900, one computation would have cost $100,000. Today $100 will buy 10 million computations. As technology and performance advance, cost declines. SOURCE: Wladawsky-Berger (2008).

Each specific technological area (mechanical, vacuum tubes, discreet transistors, integrated circuits) follows its own S curve: slow initial growth, followed by exponential growth, and then slowing and diminishing growth in capability. Kurzweil's point is that as a technology reaches maturity and capabilities fall off the exponential growth curve, a new replacement technology emerges and continues the exponential growth. These exponential curves apply to many human-made technologies over hundreds (if not thousands) of years. The committee believes that examples include our capacity to record and store information (from cave wall, to written word, to the printing press, to computer storage, to the cloud). The same can be applied to our capacity to compute, generate energy, increase the lethality of weapons, or produce food, to name a few examples.

The exponential advances of information technology (IT) growth are the result of each generation of IT going through the standard performance logistic curve and being replaced by a new generation as the older one becomes obsolete. Each new generation offers an order of performance over the generation that it replaces. In Figure 1-1, the increasing performance of computation is actually the envelope of the logistic curves for the increase of performance of the successive underlying technologies over time. The transition from one logistic curve to the next is fertile ground for the emergence of new disruptive technologies.

A system of forecasting of disruptive events needs to be developed to meet new realities that include exponential technological growth, globalism, commercialization, the rapid diffusion of technical knowledge, the viral application of technology, the proliferation of asymmetric and disruptive strategies, and changing global competitive forces. As a report by the National Intelligence Council (NIC) observed: "We see globalization—growing interconnectedness reflected in the expanded flows of information, technology, capital, goods, services, and people throughout the world—as an overarching 'mega-trend,' a force so ubiquitous that it will substantially shape all the other major trends in the world of 2020" (NIC, 2004, p. 6-7).

Traditionally, U.S. military strength has been built on a foundation of global technological superiority owing to strong technical leadership and heavy investment by the government in large platforms. As stated in an earlier NRC report, *Avoiding Surprise in an Era of Global Technology Advances,* "These sophisticated platforms now require investments of tens of billions of dollars spread over decades—investment levels that few foes can match.

However, the defined lifespan of the advanced technology in these platforms can now be less than the development cycle" (NRC, 2005, p. 46). In the Cold War world of head-to-head, platform-to-platform conflict, it was possible for groups of experts to agree on a list of emerging technologies to watch. Given the experts' knowledge of the adversary, the characteristic composition of these groups of experts—by gender (male), culture (Western, English-speaking), race (white), generation (older), organization (governmental), region (Northern Hemisphere), and sector (military), among others—may not have been a significant limitation. But the power of technological innovation no longer resides exclusively with the traditional military and economic superpowers, and developments can come from virtually anywhere.

> While U.S. technological advances in areas such as stealth technologies and satellite imagery once afforded multi-decade military advantage, the rapid pace of technological innovation driven by the global commercial marketplace is shifting the advantage to those who rapidly adopt, exploit, and integrate evolving technologies. While defense-specific investments will continue to spawn important technological advances, U.S. technological superiority is no longer assured (NRC, 2005, p. 13).

The globalization of knowledge exchange and of commerce has lowered barriers and spread the distribution of technological innovation centers throughout the world.

> No single nation—or company—can expect to innovate in isolation. That's because the global adoption of the internet, as well as advanced pervasive technologies, have stripped away the traditional barriers to innovation—such as proximity of natural resources, geographic constraints, and access to both information and insight. (Wladawsky-Berger, 2008)

The recent global recession has brought into stark relief the interdependencies of global economies. Multinational corporations can take advantage of Japanese strengths in nanotechnology, optics, and electronic devices, or be consumers of top-notch high-technology manufacturing and design in photonics in China (discussed in detail in Chapter 5 of NRC, 2005). In such an interdependent world, the definitions of ally and foe can be very fluid and flexible. In the future, the successful leaders in the global marketplace will be highly adaptive, rapidly responsive to world trends, and adept at leveraging strengths through strategic partnering.

Global commercial forces will play a major role in guiding the development of most future technologies (e.g., information technology, biotechnology, microtechnology, nanotechnology, materials, and energy). As technological research and development become increasingly driven by market opportunities and market demand, technology developed specifically to meet a military need may become a niche market. This also means that military applications and uses of commercial technology will be increasingly innovative and important. A forecasting system for disruptive technologies must incorporate global market and investment trends in addition to tracking government-funded programs.

One important result of the recent growth in globalism and commercialism is that important indicators of potentially disruptive technological developments are likely to appear in open sources—on commercial Internet sites, at industrial fairs, at trade associations, among special-interest groups, on Web blogs, and on intranets of key corporations. Many of these technologies and applications will be developed and exploited by small or obscure start-up companies or in the research efforts of young university or postdoctoral students. The committee is concerned that in the future many of these technologies will be developed outside the United States. It was observed by several committee members that many technologies that become disruptive start off as outliers—innovations that are by definition outside the mainstream consciousness.

KEY REQUIREMENTS FOR SYSTEM MODELS

This section outlines some of the most important characteristics and design elements of a disruptive technology forecasting system identified in the committee's first report (NRC, 2010) and during the workshop discussions. These characteristics were chosen by the committee for inclusion in the first report in part because they are believed to optimize the use of available technology to address the challenges mentioned earlier in this chapter.

Persistence

To accommodate the changing global landscape, the committee believes that a good disruptive technology forecasting system needs to be open to the public and persistent. Chapter 5 of the committee's first report identified persistence as one of the most important principles in a system for forecasting disruptive events (NRC, 2010).

Traditional forecasting systems provide technological snapshots that can quickly become outdated in the face of today's realities. In many cases, these one-time predictions fail to develop technology roadmaps or to include a strategy for tracking and incorporating new signals[1] that emerge after the prediction's creation. Many technology forecasts fail to explore potential secondary effects or to consider the possibilities for enabling new disruptive applications that might arise from integrating multiple technology disciplines. To capture an evolving technology trend, a forecasting system must continuously scan, sample, question, and imagine from multiple sources of information; this is what makes it "persistent" (NRC, 2010). A key goal of a persistent system is to continuously improve forecasts on the basis of new data, signals, and participant input. A persistent system can look at trends and recalculate trajectories as data change or as new events appear on the horizon, generating new hypotheses. If all of the queries posed for the participants to answer, the queries from participants to the organizers, the various hypotheses proposed, and the scenarios developed are saved and tracked, then the data to develop these potential answers, even if the answers were discarded, are not lost. For example, information developed later might create a situation that would give new meaning to scenarios that were previously considered impossible. It is difficult to ask all the right questions at the right time (Jonas, 2008). By storing each query, a previous query can be matched against a current query, which could be used in signal matching. For example, someone who is studying automotive design might be watching the falling cost of storing a unit of energy, believing that once a price hits a certain threshold, the electric motor becomes viable as a principal form of vehicle propulsion. Another person might be studying the same measure of interest for its implications for technologies interfacing with the electric power grid. The queries themselves could be an important signal.

As it generates interest among different communities, a persistent forecasting system can be built to serve many different customers, providing a continuously active, dynamic, and responsive platform. Although the sponsors are primarily concerned with national defense, disruptive technology forecasting is also useful in many types of business applications.

The outcomes of a persistent system differ from traditional methods of forecasting in the following ways:

- The forecasts of the persistent system are current and based on the best knowledge available as they advance.
- Data archives can be used as a repository for other forecasts. Currently, there is no single place within the DoD, much less the U.S. government, where technology forecasts from multiple agencies can be seen and referenced.
- A persistent data-gathering platform can be incorporated into multiple programs and applications.
- Rather than having a forecasting cycle, a persistent system allows forecasts to be generated or updated continuously as new signals appear.
- As new technologies, communities, or applications evolve, they can be integrated into the system and applied to existing work.
- As the historic base of data grows, this archive becomes a valuable resource with which to test and refine new forecasting tools and methods using backcasting (see the Glossary).

Openness and Crowdsourcing

In its first report, the committee focused on openness as an important attribute of a future forecasting system to allow the broadest possible collection of ideas, signals, and interpretations and to reduce bias (particularly Western bias) through diverse participation. Attendees at the workshop echoed the belief that input from a broad range of

[1] A "signal" is defined in the first report as a piece of data, a sign, or an event that is relevant to the identification of a potentially disruptive technology (NRC, 2010).

participants is the key to tapping into far-flung signals indicating technology change. Crowdsourcing is "the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call" (Whitford, 2008). The definition was initially discussed by Howe (2006). A forecasting system that incorporates crowdsourcing uses open participation to develop a wide range of scenarios and possible future narratives. Ideas can be drawn directly from the crowd using Web-based models that include participatory special-interest-community Web sites, predictive market tools, and interactive gaming. Crowdsourcing can also be used indirectly: sophisticated Web-based search algorithms can extract data of interest from such sources as blogs, professional association Web sites, competitions, or published literature.

Classical approaches and sources for forecasting, such as brainstorming by experts, market surveys, searches of published papers, and classic data collection can be combined with new enabling technologies and applications such as searching tweets for emerging disruptive ideas in the news. Disparate inputs inspire ideas and raise questions that feed back into iterative loops where the data are used to refine the information. For example, more interesting scenarios or narratives can be selected to be developed further and put back out to the larger crowd community in the form of an alternative reality game (ARG) to see how it plays out. Data from persistent Web crawling may also indicate a growing area of interest—a community that is attracting resources or an idea that is cropping up in interesting places—that should be explored further.

Some may consider the idea of an open forecasting system that includes crowdsourcing to be fairly radical. The rationale was that it would take a very broad range of inputs from a wide variety of global populations to have the kind of reach that would enable real forecasting and that crowdsourcing using Web-based technologies is an effective means to access global populations. Research has shown that amateurs are capable of outperforming experts in forecasting (Önkal et al., 2003; NRC, 2010). The committee believed strongly that adding crowdsourcing techniques would broaden and complement the viewpoint and data that any collection and analysis team could access and prioritize. This could significantly improve the chances of discovering disruptive indicators before the disruptive technology emerged. This improvement would result not just from the complementary data coming from open sources. Crowdsourcing techniques may demonstrate different prioritization of technologies, their applications, and hypotheses than those from traditional forecasting of technologies.

Workshop participants expressed diverse views on the superiority of crowd analysis over expert analysis. Many of the participants recognized that crowdsourcing presents unique challenges not present in other forecasting approaches. For example, it can be noisy, uneven in quality, and self-reinforcing (crowd-generated ideas include zero-point energy, human time travel, faster-than-light travel). Nevertheless, expert analysis remains subject to error due to problems such as mirroring, blind spots, and failure of imagination.

Proponents of crowdsourcing and of expert judgment at the workshop accepted the idea that both forms of analysis have a role in the forecasting process. Experts can analyze the plausibility of data feeds leading to particular scenarios or select high-impact scenarios for further exploration to discover possible paths that enable them. A key role for experts is to backcast: to begin with a projected future scenario and explore potential paths that could lead from the present to that future. The experts can either develop their own model or evaluate and validate potential paths suggested by the crowd. Fully developing a backcast model would entail laying out potentially important signposts, tipping points, thresholds, or measures of interest that could be persistently tracked for a convergence of effects. The implications and impacts of a particular scenario might not be immediately obvious, so both crowd and expert insight might be valuable. For example, if one only watches areas of interest to technology experts, minimalistic applications and technologies such as IEDs might be missed. The crowd, however, might not be able to roadmap the development of stealth technologies with the same level of precision as that offered by experts. Thus, the committee proposes that input from both experts and crowds be used to gain the strengths of both for better forecasts of disruptive technologies.

The stochastic model of creativity pioneered by D.K. Simonton (2003) states that the level of creative output can be traced directly to the breadth of the domain from which an innovator draws knowledge and the frequency with which creative efforts are attempted. Therefore, "a researcher who spends 40 hours per week engaged in theory development is more likely to develop an innovative idea than a researcher who spends only 5 hours per week on the same task . . . for creativity to flourish, both aspects of the creative process must be emphasized" (Fehr, 2009, p. 345).

Creativity and Tolerance for Failure

A forecasting system for disruptive technologies must be open to creative ideas and have tolerance for failure. By nature, a disruptive technology will be difficult to predict, and so most predictions will not be realized. Rather than predicting the occurrence of a specific innovation, a worthwhile forecast predicts the problems that will be solved with technology and the effects of different possible solutions. Therefore, it is important to develop a roadmap of many potential futures of concern and to collect signals to help track the development of key technologies that might enable a specific future.

In the opinion of the committee, the technologies that are the most disruptive are most likely to emerge from the unexpected application of both new and existing technologies. In many cases, it is the unexpected application of existing and well-understood technologies that can cause the greatest surprise and disruption. In these cases, it is the new application of technology rather than the novelty of the technologies involved that causes the disruption. Uncovering unexpected connections between existing technologies requires a tolerance for ideas that seem "crazy," and it requires creative people to contribute seemingly unrelated data that may become a significant marker when combined with other data to form a pattern. While the interpretation of the significance of the patterns can be wrong, the knowledge of such patterns is important and can be refined as new signals, data, or events emerge. The creativity necessary to envision less obvious connections is also needed to place forecasts in believable contexts. However unlikely an interpretation, it must be included in a compelling narrative of a future scenario. As in the case of Cassandra, the Greek mythological character who was able to see the future but was cursed with the inability to convince others of the truth of her predictions, accurate forecasts are useless if they cannot inspire action before a disruption emerges.

Predictions Versus Roadmaps

An effective forecasting system does not necessarily predict the future accurately. In his foreword to *The Knowledge Base of Futures Studies* (Slaughter, 1996), James Dator proposed two hypotheses and postulates for forecasting the future, known as Dator's law. The first hypothesis is that the future cannot be studied, because the future does not exist. He then postulates that the future cannot be predicted, but alternative futures can be forecast and preferred futures can be "envisioned, invented, implemented, continuously evaluated, revised, and re-envisioned" (Slaughter, 1996, p. xx). The second hypothesis is that any useful idea about the future should appear to be ridiculous from today's point of view. A related postulate is that a future considered to be the most likely is probably one of the least likely futures. Therefore, "decision-makers, and the general public, if they wish useful information about the future, should expect it to be unconventional and even shocking, offensive, and seemingly ridiculous. . . . futurists have the additional burden of making the initially ridiculous idea plausible and feasible by marshaling appropriate evidence and weaving alternative scenarios on possible developments" (Slaughter, 1996, p. xx).

Traditionally, forecasting methodologies have focused on identifying technologies, but Dator's law emphasizes the process of *envisioning futures*. The future will reflect the impacts of technologies on society, and it is these impacts, rather than the technologies that cause them, that are the essential and convincing elements in a narrative of a potential future.

A focus on technologies can also fail to incorporate other factors relevant to disruption. Some forces that enable or encourage disruptive events are not technological. For example, when Twitter was used to mobilize protests of the results of the 2009 Iranian presidential election, the power of this relatively simple new technology to affect political change by leveraging global social networks was made apparent to the world. Very simple and old technologies can also have dramatic impacts when applied to uses other than those originally intended.

A list of emerging technologies provides little basis for prioritizing their disruptive potential impact or allocating resources to the most threatening scenarios, especially if those scenarios are seen as low-probability outcomes. A set of potential future roadmaps provides the necessary insight for making better preparations for the unexpected. Like building an opening book for a chess program, a forecasting system can use roadmapping to map signals against important signposts to help identify the potential emergence of an alternative future (see

BOX 1-2
Learning from Blackjack and Chess

A good forecast should allow the user to slightly change his or her odds of success from being completely random to being slightly better than random. Think of it as card counting in blackjack. It does not guarantee that at any moment in time one is going to have a winning hand, but over the long term of playing the game out, one beats the house odds by changing it just a little bit. A good forecast is like counting cards: it does not guarantee a win; it just begins to subtly shift the odds in one's favor. And most importantly—and a lot of forecasters forget this—at the end of all the forecasts, what do we look for to see whether or not a forecast is coming true or not coming true? What are the signals, what are the signposts, what are the thresholds, what are the tipping points that we should be out there listening and monitoring for to say "Oh! It's happening"? So think of it as a chess game. You're sitting there and you're playing a grand master, and the grand master looks at the chessboard and in about 10 seconds says, "Oh, I see a pattern here. It just kind of looks like that game. I know my next eight moves." A novice looks at the board and says, "I don't know what to do next." So an early warning system is having what can be called that opening book in a chess program. Now how can we fill that opening book, and increase that pattern recognition that allows somebody to say, "Hey, this might be coming true, that may not be coming true"?

SOURCE: Committee Chair Gilman G. Louie, adapted from the unedited workshop transcript in Appendix D, provided on the CD included in the back inside cover of this report.

Box 1-2 for a more detailed example). A well-designed forecasting and warning system provides forecasters with the equivalent of an opening book. In certain cases, disruptive applications can be subtly hidden in second- and third-order effects. Like chess grand masters, experts are important to a forecasting process because of their ability to identify subtle patterns.

A useful forecast will lay out several roadmaps of potential futures, with indicators and parameters that can be used to follow the progression of events and evaluate the likelihood of each scenario's coming true. It should indicate the technological, societal, economic, or other tipping points or thresholds that might enable a disruptive scenario. The committee believes that it is important to include economic, social, and cultural experts along with scientists and technologists on a disruptive technology forecasting team.

FRAMEWORK FOR MODEL BUILDING

The workshop opened with a description of a framework for thinking about forecasting and a list of desired system attributes developed in the first report. The methodology flow diagram from that report (NRC, 2010, p. 59), reprinted here as Figure 1-2, illustrates some proven forecasting methodologies and provided a helpful example for the workshop participants to use when building their models. As shown in the diagram, forecasters begin by defining who the users are and what the mission is. Once the priorities of the mission are understood, potential sources of interesting information can be identified and pursued. Sources of information can then be collected through the pursuit of new data sources and the use of active techniques such as data mining, interviewing, and data repository acquisition and licensing as well as through more passive means such as monitoring and tracking. Generally, these sources include both data input and human input. These data then go through a data hygiene process, which restructures, eliminates duplication, and "cleans up" the data. Forecasters should be cautious about discarding data that seem irrelevant. "Bad data" could prove useful in unexpected ways and could teach forecasters how to make better inferences.

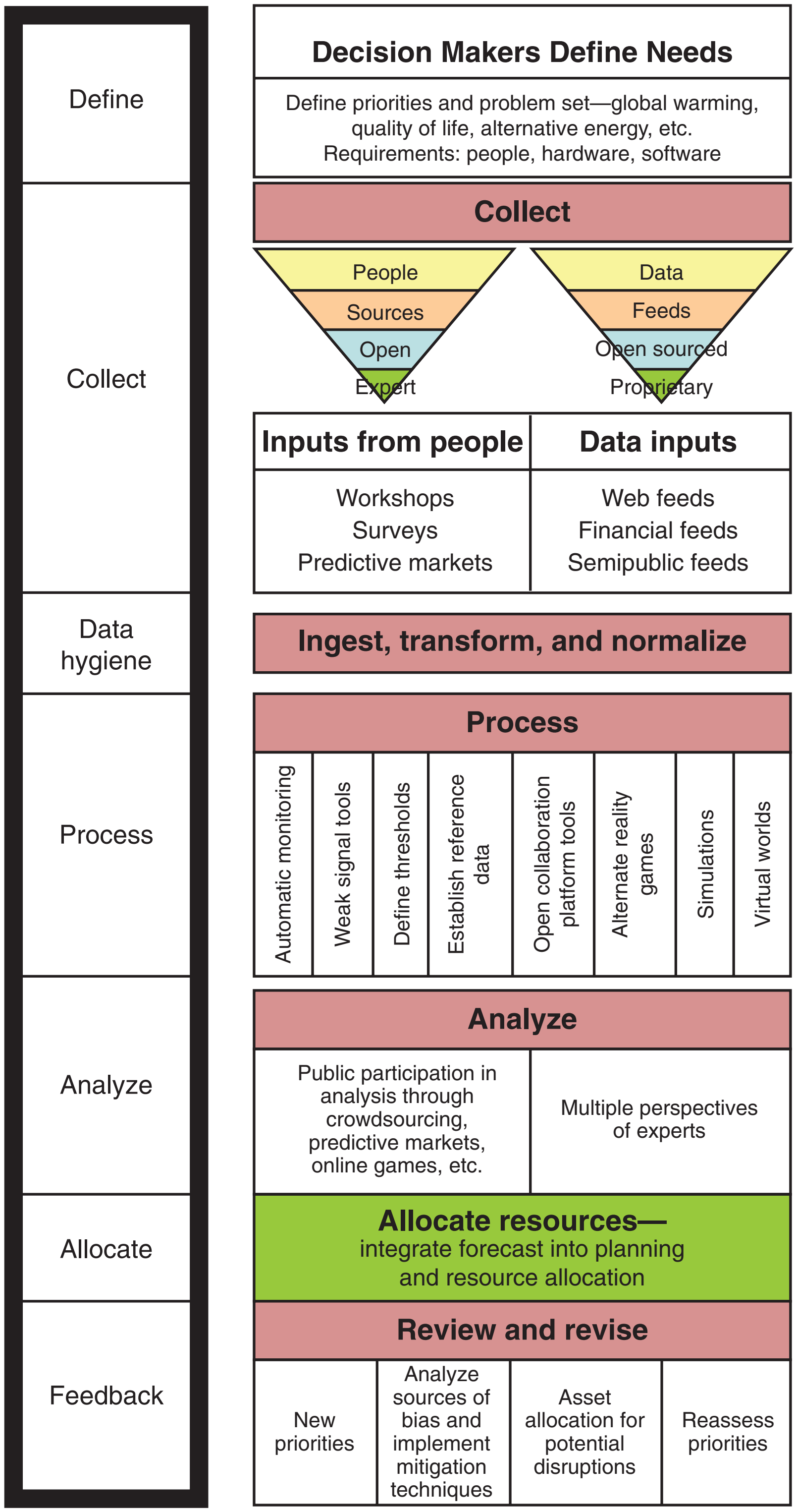

FIGURE 1-2 Conceptual process flow for the persistent forecasting system. SOURCE: Reprinted from NRC (2010), p. 59.

Observation. Even data and hypotheses that are considered irrelevant or of poor quality could be useful sometime in the future in a persistent forecasting system. Selecting "good" and "bad" data too soon has the potential to introduce bias and blind spots into a forecast. All data, questions, and hypotheses generated should be preserved.

One of the challenges inherent in any forecasting methodology is ensuring that the inputs used to derive the forecast are of the highest quality and represent a broad range of quality sources. This is especially true for persistent systems that require continuous inputs. Systems that rely on experts can control the quality of input by selecting participants with the desired composition and quality of expertise and by controlling the quality of the questions being asked. Systems that rely on data can ensure quality by ensuring that there is an understanding of the sources of data and how the data were derived. Unlike other inputs, the quality of crowdsourced data is determined more by the structure of the system than by the quality of the individual participants. Quality comes from the breadth and number of participants and the structural approach used to perform oversight of the system.

After collection, the data are processed through a number of possible mechanisms. The result of processing should be a portfolio of possible, but not necessarily probable, futures against which resources can be allocated for future tracking and reprocessing.

This methodology uses a traditional linear forecasting approach, which may be good for a one-time forecast but may be flawed for a persistent system. New tools should be able to replicate the processes that traditional forecasting systems use while incorporating rapid, continuous feedback to produce persistent, constantly updated forecasts. The committee acknowledges that the proposed model in the first report may not be the most accurate for a persistent system, but it provides a useful framework for the processes included within a single pass of a forecasting loop of a hypothetical persistent system.

INSIGHTS FROM THE WORKSHOP

After hearing briefly about the vision that the committee held for a forecasting system derived from its work on the first report and a brief description of the framework in Figure 1-2, the workshop attendees participated in a large-group discussion and then worked in subgroups to prioritize design elements; define input, output, and intermediate processes; and build models of potential forecasting systems for disruptive technologies incorporating both computer and human elements. The most salient insights and conclusions are described briefly in this section and in more depth in Chapter 3.

Flexibility and Leadership

The model-building exercise performed by the workshop participants illustrated that there are multiple viable approaches to building a high-level persistent forecasting system. Given the multitude of design options available, the committee concluded that it would be more productive to begin building a basic 1.0 system[2] to test and develop than to spend excessive resources on planning a robust and complete system structure at the outset. The design could then evolve to incorporate additional desired elements and to meet user demands. Rapid and cohesive design evolution is unlikely to occur without strong leadership and vision; therefore, the selection of the core leadership team is one of the most important elements for determining the success of the system. Desirable qualities and experience for the leadership team are presented in greater detail in the descriptions of individual models in Chapter 2.

[2] A "1.0 system" is a minimal working system with basic core functions that is used by its target users as a production system. A 1.0 system is different from a prototype, which is typically a testbed used to validate an approach with a small number of users and having a subset of the required core functions. The label "1.0" is typically given to the first fully working product that is released to its target users.

Narrative Focus

Another major concept reinforced by the workshop is the importance of a focus on developing narratives of the human use and impact of technology instead of a focus on specific technologies. It is the context of solving human needs that drives technology use. The system should therefore start by identifying big problems and big opportunities and using them to generate alternative scenarios and hypotheses from which relevant technologies can be derived. There are often multiple solution paths to solve a single problem, but the immediate and second-order effects of the different solutions might be very similar. Scenarios will also vary by region, as they will have distinct impacts and solutions in different locales. By emphasizing the narrative, forecasters avoid devoting too many resources to tracking "the wrong" solutions and technologies, stay focused on potential outcomes, and create compelling arguments that can be later presented to stakeholders.

Funding

A number of workshop attendees commented that the forecasting system should be built and funded according to a start-up model, with the government providing seed-level financing to build a working 1.0-level version of the system. Beginning the project with minimal resources forces the development team to make tough decisions up front and to focus the effort on developing and perfecting core system features. The leaders in charge of the system should be forced to seek additional outside funding sources, ensuring that the system is robust enough in the early stages to inspire confidence and attract sponsorship.

Risk Management

A number of risks could compromise a forecasting system. The committee believes that the following is a list of potential risks that need to be considered and mitigated:

- *Technology and engineering risk:* Some of the proposed systems depend on technologies such as databases, search engines, data mining, classifiers, data visualization tools, and Web tools. Although all of these individual technologies exist, developing a robust and reliable system that integrates these various technologies can be challenging even to an experienced technology team.
- *Data risk:* The quality of the output is highly dependent on the quality of the input. Operators must make sure that bias is either balanced or minimized in the data collection and analytical phases of the various approaches. Data need to be collected using a diverse set of sources to be representative of the range of technologies and impacts being forecast. Expert sources should be qualified. Great care must be given to the selection of various data sources.
- *Security vulnerability risk:* The system must be secured from various forms of malicious attacks, including spoofing, purposeful bias creation, data corruption, unauthorized modification of the data, planting of information, and denial-of-service attacks. The system, especially the portions that are crowdsourced, must be architected with appropriate security, monitoring, and analytics.
- *Leadership and personnel risk:* Start-up activities are inherently difficult. The quality of the leadership within a founding team has a major effect on the success or failure of most start-up activities. The vision, perseverance of the team, determination of purpose, and ability to execute are driven by the quality of leadership. Finding the right individual(s) to head up such an effort is critical to the success of the project.
- *Disruptive idea risk:* As with many forecasts of disruptive technology, there may be a natural tendency to reject wild or challenging ideas as either impossible or highly improbable based on the knowledge, trends, and understanding at the time of the forecast. It is important that every forecast be stored for future consideration in case of a change in understanding or fact.
- *User risk:* There are multiple user risks: (1) The system could suffer from lack of adequate participation by experts and/or the crowd. (2) Malicious users might corrupt the system. (3) Users might disclose copyrighted, proprietary, confidential, or classified materials. (4) There could be a failure to have enough diversity in the user community, resulting in a biased forecast.

- *Financial risk:* To build a persistent forecasting system, adequate and persistent funding is required. A diverse source of funding would reduce the risk of failure due to inadequate financial support.
- *Stakeholder risk:* The final risk is that the forecasts produced by the system are not used or are rejected inappropriately by stakeholders and decision makers. There may be several factors that can cause this:
  —*An unactionable forecast:* A forecast that does not provide adequate insight into potential futures results in the inability to make decisions from it. A forecast that is overly general or fails to assess potential impact results in an unactionable forecast.
  —*An unbelievable forecast:* It is difficult for stakeholders to accept a forecast that might be considered unbelievable or improbable because it may challenge current beliefs. It is important that the greater the improbability, the greater the amount of effort given to explain how an alternative future can occur from a current point in time. Roadmapping and narratives are important tools that can be deployed to mitigate this risk.
  —*Inappropriate use of a forecast*: Forecasters need to guard against the use of selective portions of a forecast to support a conclusion different from what the forecast intended. The forecast team should, whenever possible, review how stakeholders and decision makers are using the forecast and its conclusions.

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2

Model Design Options for Forecasting Systems

Your idea has to be original only in its adaptation to the problem you're working on.
—Thomas Edison

In its first report (NRC, 2010), the committee outlined the principal attributes of a forecasting system (described in Chapter 1 of this report) and created a concept diagram (see Figure 1.2) for a forecasting system for disruptive technologies. In November 2009, at the 1-day Forecasting Future Disruptive Technologies Workshop convened by the committee, three subgroups of attendees successfully designed potential 1.0 version concepts for forecasting systems that would satisfy the parameters defined in the first report. Workshop participant Stan Vonog submitted a fourth forecasting concept at the end of the day.

Each subgroup was asked to prioritize a list of key design criteria and then to use the results as a basis for building a process diagram for a forecasting system showing the essential steps of how the system works. The key design criteria were these:

- Openness
- Persistence
- Bias mitigation
- Robust and dynamic structure
- Anomaly detection
- Ease of use
- Strong visualization tools/graphical user interfaces
- Controlled vocabulary
- Incentives to participate
- Reliable data construction and maintenance

Once the process diagrams were developed, the subgroups were asked to estimate a level of effort for technical and human resources. These estimates were discussed by all workshop participants and then incorporated into the model design. This chapter contains detailed descriptions of the four proposed system models:

1. Intelligence Cycle Option
2. Roadmapping Option
3. Crowdsourced Option
4. Storytelling Option

FIRST FORECASTING SYSTEM: INTELLIGENCE CYCLE OPTION

The name Intelligence Cycle Option was given to the system design that uses an option similar to the classic approach used by the intelligence community: hypothesize, task, collect, and analyze. This system starts with a "big question," which initiates creative hypothesis generation fed by passive data collection (from movies, media, and online databases, for example) and active data gathering (e.g., crowdsourcing, games). The inputs then flow through hypothesis evaluation and testing by experts or participants in the science and technology, financial, and sociopolitical arenas or through mechanisms such as gaming and crowdsourcing. The raw output from these processes is shaped into a narrative[1] for stakeholders and then fed back into the hypothesis engine. See Figure 2-1 for the option design from the workshop.

The system design was organized around four functions:

1. The input of a "big question,"
2. Signal identification and hypothesis generation,
3. Hypothesis evaluation and testing, and
4. The authoring of potential future narratives.

The Input of a Question

The forecasting process is initiated with a big-picture question posed by the stakeholder for a particular audience (i.e., Congress, the White House) and communicated to the system director/manager (see Table 2-1 for a detailed description of the different roles). Generating the big-question-based raw hypotheses requires an understanding of the forces that shape the perspective of the customer, and this is a key responsibility of the director/manager, who is responsible for all interaction with the stakeholders. Throughout the development of the forecast, the stakeholder will receive feedback from the data, collection, hypothesis-generation, and hypothesis-evaluation processes and be able to assign parameters to ensure that the final narrative addresses the original purpose.

Another approach to generating the big question is to leverage outside experts or the crowd to suggest a list of big questions that stakeholders should consider. This list could be reduced through discussions with stakeholders to identify one or two big question(s) that should be addressed using this process. This approach is useful for finding questions that would not normally be generated by people inside a system, and it is a valuable way to avoid closed ignorance.[2]

Processes

The raw hypothesis based on the stakeholders' big question is fed into an interconnected enterprise of passive and active data gathering, analysis, and hypothesis generation. The forecasting system's hypothesis managers add a rough story and idea to the question and send the hypothesis to the passive and active analysis functions. Information is passively collected using software-centric textual and multimedia data mining and statistical analysis to identify applications, technologies, or ideas that have garnered increased interest, that cross subject areas, or cross regional boundaries. Inputs might include themes or ideas from U.S. and foreign movies and literature, electronic discussions of technologies and applications, cultural media, and volume and pricing of key technologies on eBay. Financial input might come from venture capital information sources or from internal agency sources of the government (e.g., the Federal Reserve, the Department of Energy's Energy Information Administration, the Bureau of Labor Statistics).

Social and political input might come from U.S. and foreign government organizations, academic institu-

[1]In this report, a "narrative" is defined as an account of events providing a context within which a prediction takes on broader significance.

[2]"Closed ignorance" is defined as follows: Information is available, but stakeholders are unwilling or unable to consider that some outcomes are unknown. A form of closed ignorance occurs when individuals or groups with purposeful goals or objectives find that their goals and objectives are contrary to the need to identify disruptions.

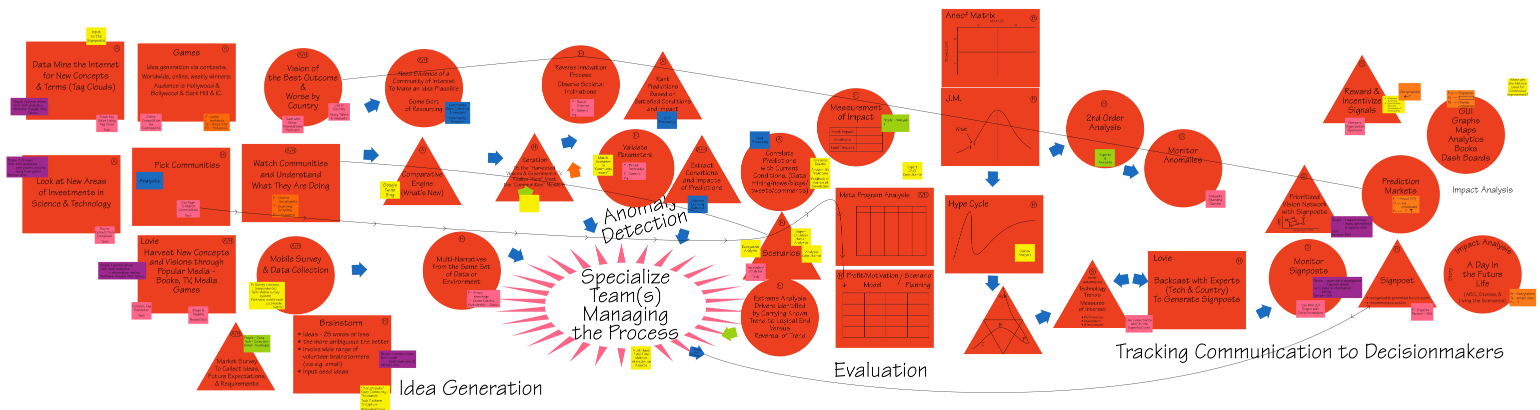

FIGURE 2-1 Intelligence Cycle Option. NOTE: The CD included in the back inside cover of this report has an enlargeable version of this figure, which is also reproduced in the PDF available at http://www.nap.edu/catalog.php?record_id=12834.

TABLE 2-1 Staff Required for the Function of the First Design Concept—Intelligence Cycle Option

Position Title	Responsibility	Desired Characteristics	Number of Staff
Forecasting system director/manager	Interact with stakeholders	Broad-thinking visionary with 10 to 20 years of experience in science and technology ventures or research and development. Prior government contracting experience a bonus. Should be pragmatic and goal-oriented.	1
Hypothesis manager	Flesh out hypotheses	Good storytellers with training and experience in science and technology	3-6
Passive data analyst	Gather and analyze data from primarily online sources	Strong information technology background with experience in search engine technology and statistics. Knowledge of algorithms for anomaly identification.	5-10
Active data analyst	Research, track, analyze, and synthesize data obtained from public data sources, subject-matter experts, U.S. government and potentially nonclassified data from intelligence community (IC) databases	Training and experience in several areas of science and technology, military experience a plus. Should be able to recognize plausibility of technologies and applications.	
Group analysis facilitator	Design and conduct live data-gathering activities using public data sources, subject-matter experts, U.S. government and potentially nonclassified data from IC databases	Experience with groupware, social networking, and online gaming systems. Teaching or sociology background, with interest in science and technology.	
Alternate-future narrative producer	Develop powerful narratives for delivery to final audience	Experience in traditional written and slideshow presentations plus storyboard development and movie or theater production. Interested and well read in science and technology.	2-4

tions, or other external activities such as gaming or crowdsourcing. Science fiction and futurist input might come from authors and online sources such as longbets.org[3] and Technovelgy.com.[4] Signals such as a change in money flows, or the sudden increase in purchases of thermo-cyclers indicative of the closing of national laboratories, or even the emergence of a new set of popular literary ideas might be used to develop existing working hypotheses or generate new raw hypotheses. Such a system can be built somewhat rapidly with a limited number of inputs to begin with and then scaled up by increasing the number and variety of information sources being mined as the forecasting system team deems necessary. Information is actively researched, analyzed, and synthesized to be fed into the raw hypothesis by forecasting system active data analysts, who research technologies, applications, and ideas from public data sources, subject-matter experts, the U.S. government, and potentially nonclassified data from intelligence community (IC) databases.

Active data analysts could also gather potentially valuable information through existing science-and-technology-focused organizations and groups that are designed to inspire the public to think of new ways of creating and adapting technology. Some examples of technology innovation competitions include the following: Imagine

[3]For more information, see http://www.longbets.org/. Last accessed January 28, 2010.
[4]For more information, see http://www.technovelgy.com/. Last accessed January 28, 2010.

Cup, which gathers 300,000 students from around the world (http://imaginecup.com/); the International Genetically Engineered Machine (IGEM) competition, an international undergraduate competition (http://2009.igem.org/Main_Page); and the Discovery Channel and 3M Young Scientist Challenge for U.S. fifth- and eighth-grade school children (http://www.youngscientistchallenge.com).

Brick-and-mortar organizations and online organizations or groups dedicated to promoting access to science and technology resources and fostering innovation (i.e., such as the Tech Museum of Innovation [www.TheTech.org] and Do It Yourself Biology [DIYBio.org]) could provide information on innovative technologies, applications, and ideas as well as provide a pool of physical and online group participants for the forecasting system.

Similarly, intra-organizational challenges, such as military innovation challenges open to all ranks, are enterprises that could be tracked by the forecasting system for innovation data and the identification of current and future innovators. For hypotheses and scenarios that the stakeholder wants to control access to, gaming and crowdsourcing could be used within Department of Defense (DoD) or IC subcommittees (e.g., enlisted military personnel with a high school diploma). The members of this subgroup were strongly intent on avoiding biases held by the highly educated. They wanted recruitment efforts directed at both "experts" and those without college degrees.

The members of the subgroup discussed how the group participation exercises should be managed, how groups could be recruited, and what form the exercises might take. The group analysis facilitators are responsible for selecting participants to provide analysis that reduces the biases noted in the first report (i.e., multinational, multiethnic, and spanning socioeconomic, educational, and expertise levels). It was generally agreed that in order to reduce bias, forecasting system team input would be limited in the passive data collection and group analysis functions. However, as a result, both functions will require a large number and variety of inputs or participants. Suggestions for methods to attract participants ranged widely from a "honey pot" approach that attracts interest from the general population to a "lightning rod" that attracts idea-oriented people rather than filtering them from a larger group. The Technology, Entertainment, and Design (TED) Web site (www.TED.com) offers a good example of what this type of incentive would look like. The TED Web site broadcasts talks from stars in their fields, who are drawn to the opportunity to speak before a prestigious audience. One workshop participant suggested the Long Now Foundation online portal as a model for what he calls "gravity wells," sites or organizations that draw people by offering the opportunity to network with important names.

When manually selecting group participants, it is easy to meet the requirements for reducing bias and to select individuals who are highly innovative or outside the norm in their field. However, dealing with self-selecting/enrolling online systems attracting users who might represent a "disruptive" community involves the paradoxical task of eliciting participation from those who are, by definition, outside the norm and who may prove to be difficult to manage in a group exercise or may provide input that has little utility when held up against even the relaxed litmus of low probability but moderate or better plausibility. (See the discussion of desirable disruptive group participants in the subsection below.) Examples of group analysis activities identified by the committee include techcasting, crowdsourcing, alternative reality games (ARGs), sponsored innovation competitions, and round-table discussions (Halal, 2009).

While round-table discussions and innovation competitions are self-explanatory and involve person-to-person interactions, techcasting, crowdsourcing, and ARG can be implemented online. Techcast(ing), as presented to the committee by William E. Halal, is a forecasting methodology described briefly on TechCast, LLC's, Web page:

> [TechCast's] researchers scan the literature and media, interview authorities, and draw on other sources to identify trends and other background data on roughly 70 emerging technologies. This data is summarized to guide the estimates of 100 technology officers, research scientists and engineers, scholars, and other experts. Results are aggregated to forecast the most likely year each breakthrough will occur, the potential economic demand, and confidence level. We find this method to be very powerful. It can forecast any issue, results are replicable within ±3 years, and the process enhances understanding. (Halal, 2009)

However, the committee noted that the system reports the statistical consensus or data clustered around the center of the bell curve of a normal distribution, which is problematic for two reasons: (1) It favors agreement and ignores potentially important disagreement represented by data at the tails of the curve, and (2) the system employs only highly educated or experienced subject-matter experts, which may adversely affect unconventional or innovative thinking.

The committee discussed the possibility of implementing variations of this method that would employ much more diverse groups to identify technologies and time lines and would report the data in the peak and tails of normal distributions, and non-normal distributions (i.e., bimodal and asymmetrical), all of which is believed to reduce bias in data analysis and to help with the identification of disruptive signals and signposts. Two group activities that were created specifically to decentralize analytical processes and leverage the participation of diverse populations are crowdsourcing and ARGs. It would be incumbent on the forecasting system group analysis facilitator to maintain his or her knowledge of existing and emerging group analysis methods and to evaluate their effectiveness when these methods are used for the forecasting system.

Desirable Disruptive Group Participants

The following are comments by the workshop participants and the committee members regarding desirable disruptive group participants.

- "One of the things that I've noticed about disruptive technologies and people who are involved in it," observed one participant, "is they're disruptive, and that's the nature of who they are."
- "If you have too much education, you learn too much about what's not supposed to be and what you can't do."
- "We want to talk to that 13-year-old who made it in his garage, not the 25-year-old graduate student well on his way to a Ph.D."
- "There's something to be said about naïveté. And that's the other people that are disruptive, that they don't know that they can't do that."
- "In the last five years, you've trained about five times more post-docs than the system could feasibly use. So you're getting a bunch of post-docs who are no longer in the academic hierarchy but still love science and would like to stay active in some capacity."

Once established, the forecasting system team may identify groups that might be considered unconventional but which, if accessed, could provide the system with valuable input (e.g., the Do It Yourself Biology community [DIYBio.org]).

As data are received and analyzed, the hypothesis managers collate the results and use them to create multiple hypotheses based on the initial raw hypothesis. The data and working hypotheses are provided to stakeholder(s), who can refine their original questions and raw hypotheses and feed them back into the system. One or more additional rounds of analysis of data and raw hypotheses to acquire more information of interest could occur, perhaps to reduce a suspected bias in a data set. For example, one focus of the additional analysis could be the posing of stakeholder questions to participants in different cultures to identify new trends, outliers, enthusiasts, or the convergence of multiple fields or money flows on a specific technology or idea, or to track the enhancers and inhibitors of technology diffusion rates. Alternatively, hypotheses might undergo another level of processing such as a technical evaluation, a prioritization of the scenarios with the greatest impact, or a policy evaluation step led by decision makers who actually allocate funds and affect policy (see Box 2-1 for dialogue from the workshop on crowdsourcing).

Hypothesis Evaluation and Testing

The quantitative analysis of hypotheses by human and software systems can use the same methods as the overall forecasting process—initiating with a question and then identifying signals and generating hypotheses; however, the scope would be pared down to focus on specific hypotheses. The goal of this process would be to analyze rather than to develop the hypotheses. As data are gathered, it is important to identify the signposts for following the progression of a potential disruption and to choose metrics that could be used to predict the timing of a disruption.

A standing committee of experts or dedicated outsourced group of analysts would coordinate the quantitative evaluation of the hypotheses taking into account technology innovation, application innovation, and precursor events. The evaluations would also include the impact of the nationality, expertise level, and socioeconomic class of the hypothesized actors. This group would apply science, technology, science fiction, financial, social, and political filters to identify signals and signposts. Input for science and technology of the future might come from the generation most likely to create it—graduate or postdoctoral students—or the national laboratories, for example.

The outputs of the hypothesis evaluation and testing function are hypotheses with accompanying evaluations, which serve a dual purpose: to generate the final potential future narratives and to contribute further to the improvement of the hypothesis generation function.

Authoring of Potential Future Narratives

Narrative writers provide the final future narratives to the stakeholders (also known as customers) and/or the users, taking into account the quantitative narrative analysis in a ranking-type scheme, which will address normal and outlier data and give voice to both the consensus and the unorthodox opinions. The narrative writers could take into account science and technology, social, political, and financial rumors as well as science fiction and fantasy as they address plausibility, inhibitors and accelerators of progress, and convergence or divergence of applications. It is important to keep in mind that the stakeholders or customers (who pose the original questions to the system) and the audience (who might be asked to act on the results of a forecast) may be the same entity; or, the audience may be a separate entity that will receive a briefing from the stakeholder or the forecasting group for information and/or decision support. This process will also provide feedback to the hypothesis generation and hypothesis evaluation functions as well as identifying new big-picture questions for the stakeholders.

The format of the narratives needs to be very compelling or even provocative to have value and to motivate decision makers to take action before the actual event, attract participants to the system, and effectively communicate the data and analysis. Multimedia and video storytelling might make the most effective presentations of the scenarios. Scenarios could be presented as movie shorts or put on the Internet or turned into an ARG or simulation that people can play for several days. The predictive value of the narratives could be tracked using portfolio assessment tools to provide the organization and future stakeholders with a metric to reference for future big questions.

Forecasting System Attributes

The committee maintained, from the earliest meetings that it held during the course of this study through the workshop, that a persistent forecasting system must be quantitative, self-learning, and inclusive of the improbable technologies, imaginative applications of technologies, and the unconventional ideas and beliefs that spawn them. As discussed previously, software systems can apply statistical analysis and identify outliers in normal and non-normal data distributions. A further software solution to anomaly detection could be thought of as a continuous exceptions-analysis machine that is fed key words or phrases and returns the outliers, as opposed to Google's algorithms that search for commonalities. Such automated approaches would certainly help to identify both the expected signals and signposts, which would be highly probable and plausible, as well as identify the anomalous signals and signposts, which would be plausible but of moderate to low probability. The manual application of anomaly detection and evaluation will be critical to the building and early analysis of working hypotheses and the evaluation of the final hypotheses, prior to narrative production. One workshop participant postulated that this is simply a matter of "cultivating a proper sense of the weird." It was suggested that analysts leverage the Internet by choosing a network and pulling in group conversations, or monitoring existing conversations and asking questions to extract unusual threads. This skill set will need to be sought in forecasting system team members from the beginning and actively nurtured within the organization.

The self-learning aspect of the system is ensured by the design of the system, an interconnected group of functions that feed forward, sideways, and backward on the flowchart to allow for revision and refinement throughout the hypothesis generation and evaluation processes. Two other system elements are also critical to the learning system. The first is system scope—concurrent projects for one or more stakeholders will enhance the data collec-

BOX 2-1
Methods and Benefits of Crowdsourcing

Following are quotations on methods and benefits of crowdsourcing from participants in the Forecasting Future Disruptive Technologies Workshop held November 5, 2009, in San Francisco.

- "In the financial markets, you have massive and immediate feedback, either amplifying or dampening, because as an analyst we put out a report that has a thesis on it, [with] . . . a constructive narrative on why we think our thesis is right. And it's amazing how quickly I got calls that said, 'You're full of garbage, basically, on this and here's the reasons why.' So you want something that stimulates that type of reaction. You need some kind of broadcast of the narrative to a group that has incentive to respond. . . . Maybe it goes to the comment about this grand challenge of being provocative in a heretical way as a very creative way of getting a strong, rapid response that's broad-based."

  Response to the statement that the system needs stewards to put provocative issues out there: "And the good thing about that too is that when people really want to put you down, they'll try and bring their evidence in to prove their point. And then those folks who agree with you are going to bring their evidence in to prove your point, which may be different than yours . . . that stoke the fire and are really important."
- "In business marketing sometimes you put out a press release as bait to get media to respond and carry your message. [The go-to-market strategy is] . . . you send these things out in varying kinds of methodical cadences over time, and you start to get reflections back from the market on the messages that you sent out. And that's when you know that you've hit a qualitative point of return where you know your message stuck and you move on to the next message.

"So in terms of what was being said about something provocative that evokes a response, it's almost like the tool has got to have some mechanism to launch these little missiles out that engender that kind of bang, and develop it so it has a cadence over time so you're constantly testing, bouncing an idea, getting that echo of a response. Because the response isn't necessarily going to come at you immediately, sometimes it takes months. But it will come if you have the right content and message.

"From the standpoint of communication and messaging and how you got the responses back, typically they're latent. They're there . . . just beneath the surface. And when you put something out there, people respond to it because it's already on their mind, just right beneath their skin. It's been bothering them for a while and then, boom, that was the trigger that got it out. . . . But those are trigger points on the edges that you want to be able to look at and say okay, who reacted to that and why?"

tion, data/hypothesis analysis, and hypothesis generation functions of the forecasting system; the second is temporality—the continuous passive monitoring of previously identified signals and the periodic review of previous hypotheses and narratives as the system ages over time will enhance current and future projects.

Although not formally presented due to the myriad forms that it could take, the system will incorporate a quantitative ranking or scoring system that will be consistent throughout the forecasting system's functional areas and will provide a numerical assignment of values to factors, such as probability and plausibility, for technologies, applications, ideas, hypotheses, and narrative outlines.

Forms of the Forecasting System

The workshop participants and the committee members discussed what forms the system organization might take and how it could be funded. The most immediately identified form is for an existing governmental or nongov-

- "There's something on the prediction markets called 'long bets,' where if you have two people with opposing points of view they go on record with an accountable prediction. 'Accountable prediction' is a person's name on a verifiable statement about something that will or will not happen by a certain time in the future and their theory of the world that makes that particular thing come to pass or not. The accountability is that this is kept online. It's voted on, it's argued about, and then the time comes to pass and it happens or it doesn't.

  "Martin Rees has one and nobody's taking the other side. It's at http://www.longbets.org/9, an arena for accountable predictions, where you can also vote on the predictions."

Prediction 9

Duration 18 years (02002-02020)
"By 2020, bioterror or bioerror will lead to one million casualties in a single event."

Predictor
Martin Rees, Sir Martin Rees is Royal Society Professor at Cambridge University.

SOURCE: From http://www.longbets.org/9 as of November 2009.

- "I think it's useful for detecting anomalies to assume a short period of time. Because you find an outlier within some set of coordinates." A workshop participant mentioned that the founder of Crowdcast (www.crowdcast.com) had worked for a game company that needed to predict when its products would ship and how many units it would sell. They were wrong all the time.

  "And he found out if you talk on a soccer field to different people [crowdsourcing], you can be so much more accurate in those predictions." So he started his own company "that makes predictions that are 60% more accurate. But that's short term [forecasting]."
- One participant suggested that there should be a ranking measurement or odds on the system outputs, an accountability as with long bets, only formalized for the whole process. "The whole reason this exercise is occurring is because people are not happy with the outputs they're getting, or they're not getting outputs at all, or they're so wildly off the mark. . . ."
- Another participant objected to the concept of expert ranking and delivering an expert consensus to the customer. "One, I don't want to trust everything to the experts, which we've built into the system we're not going to do. Two, I don't like throwing out the outliers. But if we generate a ranking analysis and we report both the consensus and the outliers with the scores, then we can go back in each iteration and say how successful the consensus was in prediction and how successful was the outlier in prediction."

ernmental organization to implement the forecasting system as a proprietary organization with proprietary software, which recruits and manages external participant groups solely for data and hypothesis evaluation.

A second proposed form would establish the forecasting system as a paid membership organization, open to individuals, private companies, nonprofit organizations, and governmental organizations with an interest in using a persistent forecasting system or becoming contributing members of the forecasting system's analysis and evaluation functions. In such a system, the previously defined stakeholders/customers, analysts, and audiences can be considered "users" of the system, and some users can have multiple roles. Given the high degree of flexibility and interactivity in such an open forecasting system, it would be important for the director/manager to give guidance continually on the various functions of the staff and virtual team in asking the right questions and finding the best sources and resources to create useful answers.

A third proposed form would essentially operate a proprietary and an open forecasting system simultaneously to serve both a proprietary community and the open-access community: that is, a proprietary secure DoD persistent forecasting system and a nonprofit open-access persistent forecasting community.

SECOND FORECASTING SYSTEM: ROADMAPPING OPTION

The second proposed system model—the Roadmapping Option—focuses on developing roadmaps from the present to predicted future scenarios based on collected data, including observations from communities of interest. The key to this model is the generation of signposts that can be monitored as the roadmap progresses. The elements of the system are these:

1. Idea generation;
2. Techniques for mapping, processing, and evaluating inputs; and
3. Communication to decision makers.

This design starts with the selection of existing communities that are experimenting to solve problems. The subgroup decided that for the 1.0 version, a limited number of communities of interest should be monitored in order to gain an understanding of their activities. These communities of interest should have a lot of activity and resources—both human and capital—behind them. See Figure 2-2 for the actual design work from the workshop.

Ideas collected from these communities and using other traditional data-gathering techniques are used to develop future scenarios to be explored. The collected ideas then need to be filtered and spun into narratives. The predictions or hypotheses generated from the narratives are then correlated with current events, mapped to current trends and models, and explored by different communities to test their validity. Refined hypotheses or narratives are analyzed to determine the impacts of and paths to their realization. Experts backcast by predicting, based on a forecasted future event, a roadmap of how that event might occur, including the signposts and signals that indicate progress. The forecasting system then searches for signposts and signals that correlate with scenarios. As data accumulate and correspond to the narratives, some emerge as more relevant than others. Ultimately, the signals, signs, scenarios, and their impacts are reported to decision makers. Because this reporting needs to be useful and understandable from a personal perspective, it should emphasize the impacts that each scenario will have on individual lives. All of the final output is used to create new input and ideas for the system.

Generating Ideas

In this system, the initiating process consists of picking communities of interest, watching what members are doing, and generating ideas about future developments based on those activities. For the forecasting system, the existence of a community of interest is needed to make an idea plausible. The team actively observes the selected communities to gather four categories of data: topics about which there is deep uncertainty (the unknown unknown), topics that are known to exist but about which not much is known (the known unknown), topics that are well understood (the known known), and topics that represent overlooked knowledge (the unknown knowns; see Table 2-2).

In the category of the unknown unknown, data-gathering activities might focus on technology experimentation and themes from science fiction to generate theories and test their viability. In the category of known knowns, looking for the rapid adoption of well-understood technologies in new emerging markets or the application of reverse innovation could indicate a disruption is about to take place (Bhan, 2010; Govindarajan, 2009). In the category of the known unknown, interest-based communities are the key. The team continuously identifies unknown topics and casts a net for more information on those topics, seeking individuals and communities that hold the missing knowledge. The more open and broad the reach of the system, the more robust will be its ability to catch needed information. Part of the challenge in this task is reaching constrained communities in remote areas. For example, one group member suggested that cellular telephone technology might be used to access isolated communities that do not have access to the World Wide Web for surveys and data collection.

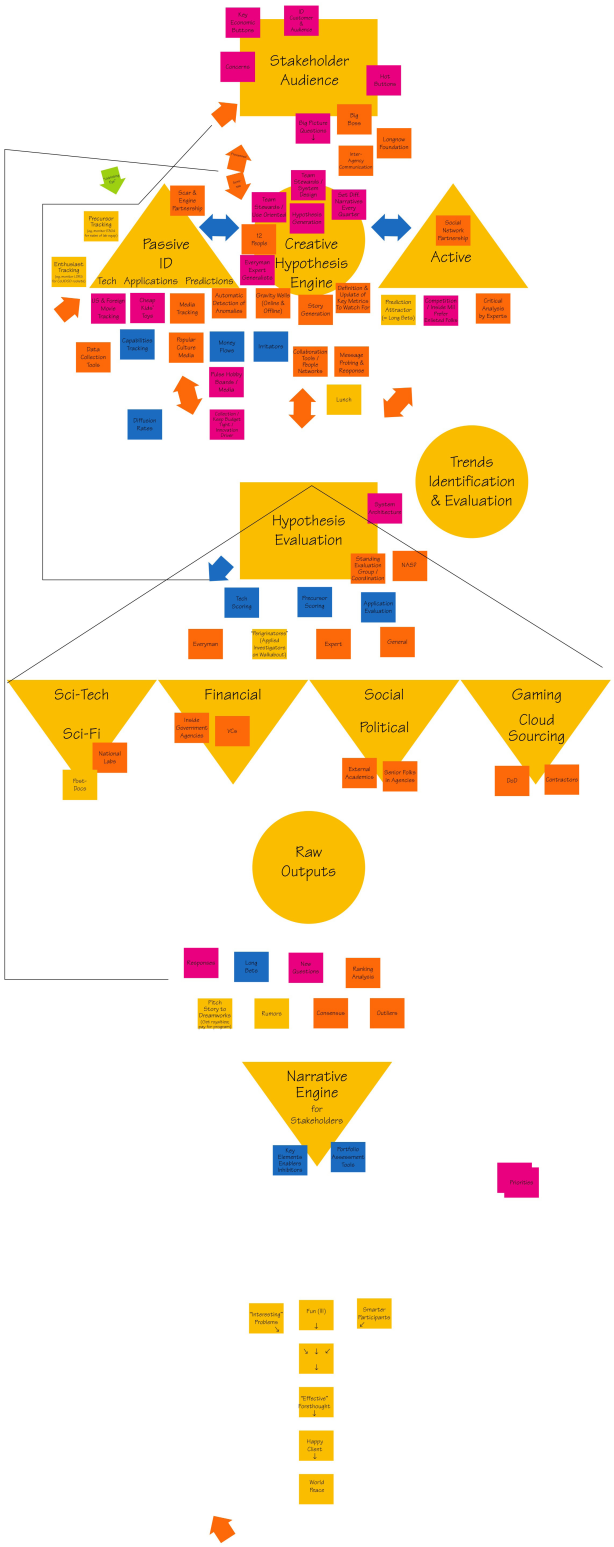

FIGURE 2-2 Roadmapping Option. NOTE: The CD included in the back inside cover of this report has an enlargeable version of this figure, which is also reproduced in the PDF available at http://www.nap.edu/catalog.php?record_id=12834.

TABLE 2-2 Categories of Information for Data Gathering for the Roadmapping Option

	Known	Unknown
Unknown	unknown knowns (overlooked knowledge)	unknown unknowns (deep uncertainty)
Known	known knowns (mastered futures)	known unknowns (research priorities)

The inputs that come back are refined and qualified, shaped or formed by the team. At this point the team's most important role begins: that of quantifying data and ensuring that fundamental principles are observed and that assumptions have not changed. Validated pieces of information make up clues that contribute to the whole, which grows and adjusts as data are added. Traditional surveys of communities are one way to quantify the data. In the process of harvesting, data mining, and brainstorming, there is also an iterative process of experimentation in the selected communities to realize the team's hypothetical visions and test whether or not they meet the communities' needs. If they do, the scenario building continues. If they do not, the scenario might be adjusted or rethought or matched to address different community issues.

The types of signals collected will vary by community. In countries, signals can be found in political rhetoric. In companies, the system might look for a corporate culture expressed in slogans, information on how the people in the workforce treat one another, what is important to them, what they value, how they speak. Semantic analysis and natural language processing technologies are being developed to assist in the evaluation of text and speech, and they could be used to help identify interesting problems that might merit an extra expenditure of resources. These emerging technologies are currently being used by commercial companies to analyze language patterns in order to obtain insights into the ways that people and communities communicate and operate. Blogs can be searched for certain themes that people are asking about or problems that are being addressed. The system team studies conditions that allow innovators to arise—root causes and conditions that allow innovators to be successful or that spur communities to act. There might be thresholds at which something becomes unacceptable and spurs action. Monitoring to detect anomalies would be based on defined thresholds. An estimate of a threshold is a judgment that could be dynamically changing. These thresholds would be very dependent on culture. Another spur to action is people seeing something that works in solving some part of their issues and innovating from there. The team observes communities to understand their issues and what they are working on. What are the problem spaces and the opportunity spaces that naturally incentivize innovation?

The system team could employ classic techniques such as brainstorming, Web crawling, and market surveys as well as classic methods with a twist. For example, the workshop group discussed using prediction markets, not for predictions, but to evaluate and analyze signposts—when a signpost might hit, or the probability of a signpost becoming real. Information toward predictions can be extracted from and correlated with data from games, tweets, news, blogs, paper abstracts, articles, book summaries, and comments on the rest. The correlating of data results in an evaluation of the words, a list of words, and a ranking of relevance to track.

The team can also actively solicit or generate ideas with activities such as a worldwide online contest with weekly winners. The audience might be Hollywood, Bollywood, Sand Hill Road,[5] or the intelligence community. The team might sponsor gaming, in which participants play in virtual worlds based on proposed scenarios. To brainstorm ideas, the team might go to specific communities—random communities, expert communities, or enthusiast communities involving a wide range of volunteers—to brainstorm by means of e-mail technology to get and seed succinct ideas. The system team integrates the ideas and other data into multiple narratives.

Most of the techniques for collecting data can be done in parallel or simultaneously. Both human and automated systems can perform the calculation and extract the signals and signposts for a potential future.

The system can automatically data mine the Internet for new concepts and terms; search tag clouds; harvest social networks; and look at summaries, such as those found on Amazon, to extract classes and themes from books, television, movies, and games. There are specific models of technical evolution that should be correlated against the ideas being generated and the signals that are observed. The searches will look for technology as well as human conditions and intersecting plots. The system's comparative engine, for example, surveys different media automatically and notes changes.

It will require human work to do the creative envisioning. A technique for extending the breadth and reach of the ideas being collected is to take an observed trend and to extend it to an irrational extreme or to assume the opposite: that the trend (for example, the concentration of population into urban areas) reverses. Then take that trend in the opposite direction, to the opposite extreme. This technique is similar to the "what if" exercise that inspires science fiction, and filtering ideas from the corpus of science fiction can contribute to generating ideas. The purpose is to generate the outliers, the scenarios on the fringe.

Another possible technique for identifying extremes is to ask the communities of interest two simple questions: What is the thing that worries you the most? and What is the thing that you would really like to see happen? The survey responses would also identify underlying differences in values and worldview. If segmented by region, the metadata would capture and allow an understanding of regional biases—cultural, economic, technological, and so on. There might be differentiation between signals from a government leader and an ordinary citizen, but the vision could come from anyone. When Mahatma Gandhi rose to prominence in India, it changed the country and the world. It is useful to segment all the data and track demographic change.

From any point of entry, the system team can ask what the best-case scenario vision is and what the worst nightmare is. Once a future vision or narrative of interest is identified, the team or experts build maps that go to that place. From the roadmaps, signals and signposts, like road signs along the way, are identified. This is the map of the potential future against which the system matches data signals from its tracking and monitoring. At the workshop, Committee Chair Gilman G. Louie observed, "Mapping is important because you want to be able to touch each one of those [narrative] lines and whatever your impulse is—whether you're following experimentation in communities or science fiction writing and possibly literature or funded research or venture capital, it should be addressing forecast signals and signposts."

One way of developing a roadmap is to take an alternative future and let the experts draw a map of how to get there. They might start with a roadmap that assumes no "miracles" but simply extrapolates from current trends, from what is known. Layered on top of that could be a look at what happens if there is a miracle. How would that event disrupt the pathway to get to that alternative future? Would it speed it up? Block it? Take it down another path? In the end, the roadmap has many roads and signals and signposts on the map. The roads or paths themselves do not need to be analyzed. What is important is the signals that indicate which road is being taken. The analysis of potential scenarios and a breakdown into signs and signals are critical to this forecast system. Signals are so important that they should be rewarded. Any input that delivers a useful signal should be encouraged.

Evaluation Techniques

The techniques for idea generation—automated as well as active—can generate numerous ideas from high-speed processes. The group raised the issue of whether the evaluative mechanisms, which might be labor-intensive,

[5]Bollywood, the largest film producer in India; Sand Hill Road, a road in Menlo Park, California, known for its concentration of venture capital companies.

could scale up to the speed of idea generation. Also discussed was the issue of processing and evaluating inputs, including weak signals, so as to filter data that are not relevant, identify significance, and find even the weak relevant signals without the system's getting overwhelmed.

Roadmapping is key. If the roadmap to a prediction is structured correctly, there are conditions, thresholds, signals, and signposts that have to be met to proceed toward a particular future. Thus the news or current articles can be mined for all the data possible from the areas that would satisfy the roadmap conditions.

A workshop participant pointed out, "On the machine side, we have lots of techniques for turning the crank and generating signposts. Once we know what we're looking for—what the search terms are that we're interested in—then we can find technology trends and measure things of interest like the energy density of batteries.[6] You can measure that in several different ways, in many dimensions. You generally need measures of interest, but there are ways to get signposts without measures of interest. The signpost is a recognizable potential future event that also has a recommended action. If it's not actionable, it's just a signal, an indicator, or some place on a measure of interest. With signposts, you can then synthesize what we could call the roadmap with lots of roads." It is a two-dimensional path. The signposts can indicate the potential future. The analysis of the potential futures refines the signposts. The analysis of the signposts can prioritize the paths or roads to the future.

Another technique offered by one participant involved ranking the relevance of paths or roads to the future as a way to offer priorities without eliminating outliers too quickly. He suggested asking both experts and generalists to assign relevance to each roadmap using a five-point scale. Each rater would also rank the projected level of impact of a technology and his or her level of expertise and level of certainty about the ranking. That ranking can then be used to tally a weighted vote.

Communication to Decision Makers

The strong roadmaps and scenarios that emerge from this process form the basis for a forecast that is eventually reported to a decision maker. The report would include the signals, signposts, scenarios, and impact of the forecast. As much as possible, the impact of the scenario must be analyzed in the context of human issues in everyday life to make it relevant, understandable, and accessible. The presentation could use dashboards, maps, diagrams, or storyboards to illustrate a "day in the life" of the forecasted future. To make it even more compelling, the story could be in the context of a game, a movie, or short work of fiction. A benefit to creating a story for presentation is that this facilitates the use of an individual's point of view, particular to where that person lives in the world and how a technology is uniquely going to affect the person. The objective of this style of presentation is to move decision makers to take action.

THIRD FORECASTING SYSTEM: CROWDSOURCED OPTION

The third workshop subgroup's proposed forecasting system—the Crowdsourced Option—is organized by input, analytical approaches, and outputs, with a clear focus on creating clear, actionable outputs in the form of reports. It is called the Crowdsourced Option because of its use of open participation from "the crowd" (either the general public or targeted populations) to gather forecasting inputs. These inputs are analyzed in multiple ways, employing a combination of crowdsourcing techniques and expert analysis. The final analysis is done by the members or delegates of an expert forecasting committee. If this endeavor were to be conceptualized as a business, the expert forecasting committee would be the founding board. That committee, or its delegates, would respond to a specific query from a stakeholder or sponsor. It would then be the responsibility of the expert forecasting committee to produce regular, systematic reports. Reports could also be made on interesting signals, events, or technologies that were independent of a customer query. Figure 2-3 illustrates the subgroup's model design.

The public face of this system would be "Disruptipedia," an online portal where data, information, live questions and responses, signs, signposts, forecasts, scenarios, and narratives would be displayed. To attract contribu-

[6] The committee notes here that it might also be interesting to use machine techniques such as anomaly detection and new-concept detection to help the forecasting system identify things that are important but that it is not looking for.

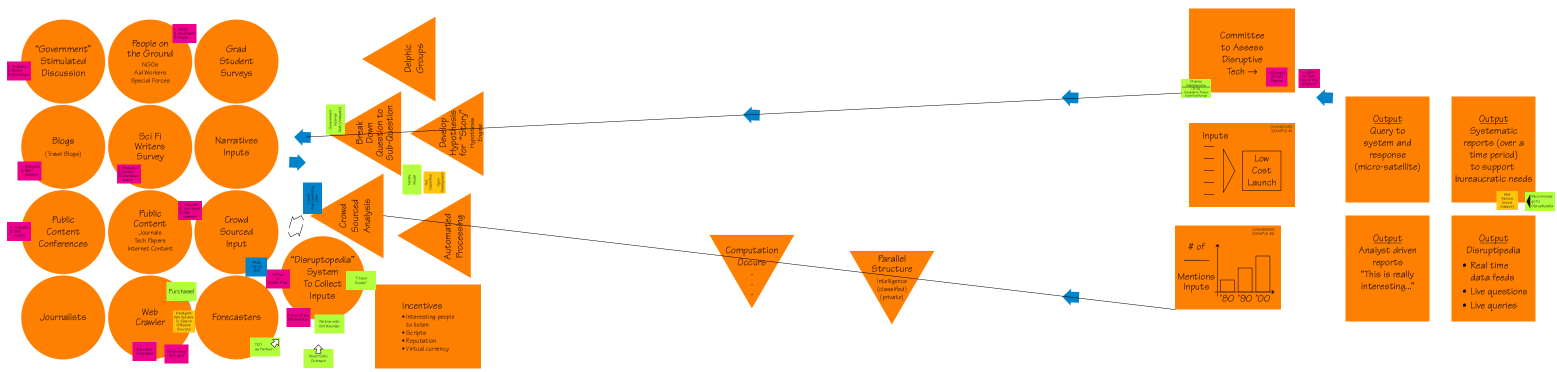

FIGURE 2-3 Crowdsourced Option. NOTE: The CD included in the back inside cover of this report has an enlargeable version of this figure, which is also reproduced in the PDF available at http://www.nap.edu/catalog.php?record_id=12834.

tions from smart, observant, knowledgeable people, incentives could include real or virtual currency or the attention of influential people. One idea was to include on the expert forecasting committee notable figures by whom contributors might want to be heard—Steve Jobs, Apple cofounder and CEO; filmmaker Steven Spielberg; or actress Uma Thurman, for example. The input could have an alternate use that would be beneficial to creative people—as a source for movie script ideas, for example. Such an arrangement could therefore be mutually beneficial to the expert forecasting committee members and to participants. Disruptipedia would serve as a living repository for the gathered information so that consistent data, information, and language could be accessed through the decades as the system grew. It would be both the constitution and the archive of this method. While such a site might help others exploit disruptive ideas and create disruption, the publishing of these ideas could likewise help the public better prepare for potential shocks caused from disruptive activities.

Inputs

Just as anything that goes into the production of a vehicle is an input, any information contributed to Disruptipedia would be an input. Inputs to the system start with narratives. Narratives can be inputs, outputs, or something between. The process is circular—narratives both feed and answer questions and act in data gathering.

To get input from people not in the mainstream, those who might be more likely to be thinking outside the conventions, the system might want to have personnel talking with and listening to people in remote areas. Forecasters should seek to understand the cultural and political context of remote populations to comprehend better the potentially globally disruptive effects of modern technologies introduced to these areas. Historical examples include cellular telephones, AK-47 assault rifles, shoulder-launched antiaircraft and antitank missiles, computers with Internet access, and improvised explosive devices (IEDs). See Table 2-3 for suggestions on how to collect additional data. It might be advantageous to have people on the ground in remote places talking with local residents, who might not have access to computers. People on the ground in remote places could be part of data-gathering staff as information came in from the field through stories being captured by journalists or the blogs of travelers or stories from workers for nongovernmental organizations.

Processes

There is a role for both human and machine processing in the Crowdsourcing Option. The qualitative processing would rely on human judgment, but there could be some automated computation and quantitative number crunching feeding into the human processing. Like any manufacturing process, it is possible to put in place the concepts outlined for the third forecasting method without equipment, information technology (IT), or systems. There are also methods to implement this system with the maximum amount of infrastructure. The degree to which automation, IT systems, and other infrastructure would be used to execute this method would be dictated by the founding team and the resources that could be secured. It is the committee's belief that the resources needed are minimal.

There are also automated tools that are useful for collecting information and doing first-level processing on it. For example, a Web crawler could be developed to crawl all known terrorist Web sites, extract all the first- and second-level data from the sites, apply statistical machine translation, and perform topic classification or classification according to key words that are constantly being identified. These tools might not be extremely accurate at the end of all of those automated steps, because the technology for translating between languages and text categorization is still emerging, but signals would continue to emerge. Especially if a technology is emerging as a disruptive technology, the signals will persist and the crawling persists. So over time, the automated processing should find significant trends, signposts, or indicators—in markets, among technologies, concepts in conversation—to track.

Inputs could be broken down into smaller questions, an internal task for the operating group that supports the expert forecasting committee. A "hypothesis engine" could develop hypotheses for narratives. Some of the inputs could undergo automated processing, including those inputs that are quantitative in nature or which can be passed through text analysis or other systematic analytical tools. The data collected could be analyzed by expert groups, undergo crowdsourced analysis, or feed discussion by Delphic groups. Ultimately, the inputs are analyzed by the

TABLE 2-3 Inputs and Data-Collection Methods for the Crowdsourcing Option

Source	Data-Collection Methods, Tools, Human Resources
Blogs	Analysts
Travel logs	Web crawlers
Public content conferences	Analysts Text search
Public content journals	Analysts
Technical papers	Technical team
Internet content	Web or markets
Science-fiction writers survey	Analysts Events Literature search
Government-stimulated discussion	Responses to requests Survey data
Crowdsourced input	Prize: trip to Technology, Entertainment, and Design (TED) Conference
Graduate student survey and dissertations	Three paragraphs on what the writer thinks is the "coolest" technology in his or her field
Web crawlers	Intelligent Web spiders to search differences Purchase
Web scraping	Partner with company Eighty Legs to outsource Web scraping
Forecasters/forecaster shepherding	People who pull from Disruptipedia concepts for envisioning the future like artists
Disruptipedia system to collect inputs	Chaos kiosks Partnership with the Smithsonian Institution X-Prize Netflix automated processing model Insurance companies' databases TED as partner Public outreach

expert forecasting committee. These analysts attend conferences, workshops, or laboratories, listening to company presentations and constantly gathering information, then debating and discussing it in order to accomplish the following:

- Identify discontinuities;
- Engage decision makers;
- Interface with the output and users to learn about the quality of data inputs, methodologies used for analysis, and ways to improve the forecasting effort; and
- Study how to continually refine the inputs and improve the methodologies of analysis.

An example process might look like the intelligence community submitting a question to the expert forecasting committee: "Is there any chance in the next 10 to 15 years that somebody's going to develop a really low-cost way of getting satellites up—cheap and fast?" The query would be broken down into subquestions and fed through the input sources, with hypotheses developed for how this might happen. The query might be logged onto a kind of dashboard that would consistently and persistently survey the data. It might produce something that indicated the number of mentions of particular types of inputs from specific sectors. Low-cost launch might be a function of propulsion, fuels, or guidance systems, which would be tracked. After inputs are received, likely scenarios or hypotheses for the story would be expertly developed as the response to the question and delivered back to the customer. In the process of developing the information, interest confluences or technologies that are moving rapidly would be identified for tracking.

Outputs

The subgroup defined four types of products that would be outputs of the system:

1. A response to a query to the system;
2. Analyst-driven reports about topics of further interest, such as "A Global Outlook on Bio-Augmentation," or "The State of Disruptive Technologies in Sub-Saharan Africa";
3. Periodic reporting out and/or systematic reports over a time period to inform the sponsor or stakeholder; shorter quarterly and longer annual reports that review the status of the system and its outputs; and
4. The real-time data feeds, live questions, and live queries that would be part of the Disruptipedia display. User-facing output could be anything that the user found interesting—ideas, raw data, or narratives.

Structure

The committee believes that, as illustrated by the collaborative encyclopedia Wikipedia, the more open a public interface is, the higher the probability of broad contribution and the higher the value of the knowledge that can emerge from it. Although the use of Disruptipedia as an interface for use by a small group would be feasible, increasing openness would create improvements in the data gathered. Some uses of the information might need to be classified, and some information, due to the original source of the information, might need to be kept private or marked proprietary. To accommodate such different needs and interests, it might be useful to have separate, parallel processes. Crowdsourced analysis would be open to the public. The government may need a classified process. Access to this system would broaden the government's reach and vision into potential disruptive technologies. The capacity to analyze the forecasting results could be broadened by mashing up the analysis community with the modeling and simulation community and cross-training them on some of the new tools areas and methodologies. There might also be a need for a separate process for things that may have federal or legal implications that are not for general public consumption.

The initiation of this forecasting system calls for an independent organization to oversee the implementation and execution of the model. To return to the manufacturing metaphor used to drive the focus here on outputs, it can also be applied to the nature in which this concept is seeded. The model for this endeavor should probably be a corporate approach, a company with an advisory board. At its outset, the endeavor would need to be flexible, focused on keeping the consumers of its reports content, and committed to the long term. A start-up manufacturing organization needs its own plant; it is too different from current operations and would be orphaned in a large existing shop floor (a division of a bureaucracy or existing organization), and it is also too different from the laboratory where the early processes were outlined (the committee that has contemplated these challenges).

Resources

The subgroup brainstormed different estimates of the resources that this system might require. If the government invested $10 million a year for a decade and the result was to diversify risk across a number of different technology sections, then it would be worthwhile. On the opposite side of the scale, if the government invested $1 million over 10 years, that would only pay the salary for one person, and it would be necessary to leverage that funding with some other kind of funds generated by the value of the system itself.

FOURTH FORECASTING SYSTEM: STORYTELLING OPTION

The fourth option proposed for a system model—called the Storytelling Option—was drawn up by workshop attendee Stan Vonog, inspired by his subgroup's decision to prioritize narrative. The system, drawn from the world of entertainment, is a novel organizational option used by Walt Disney in 1943.

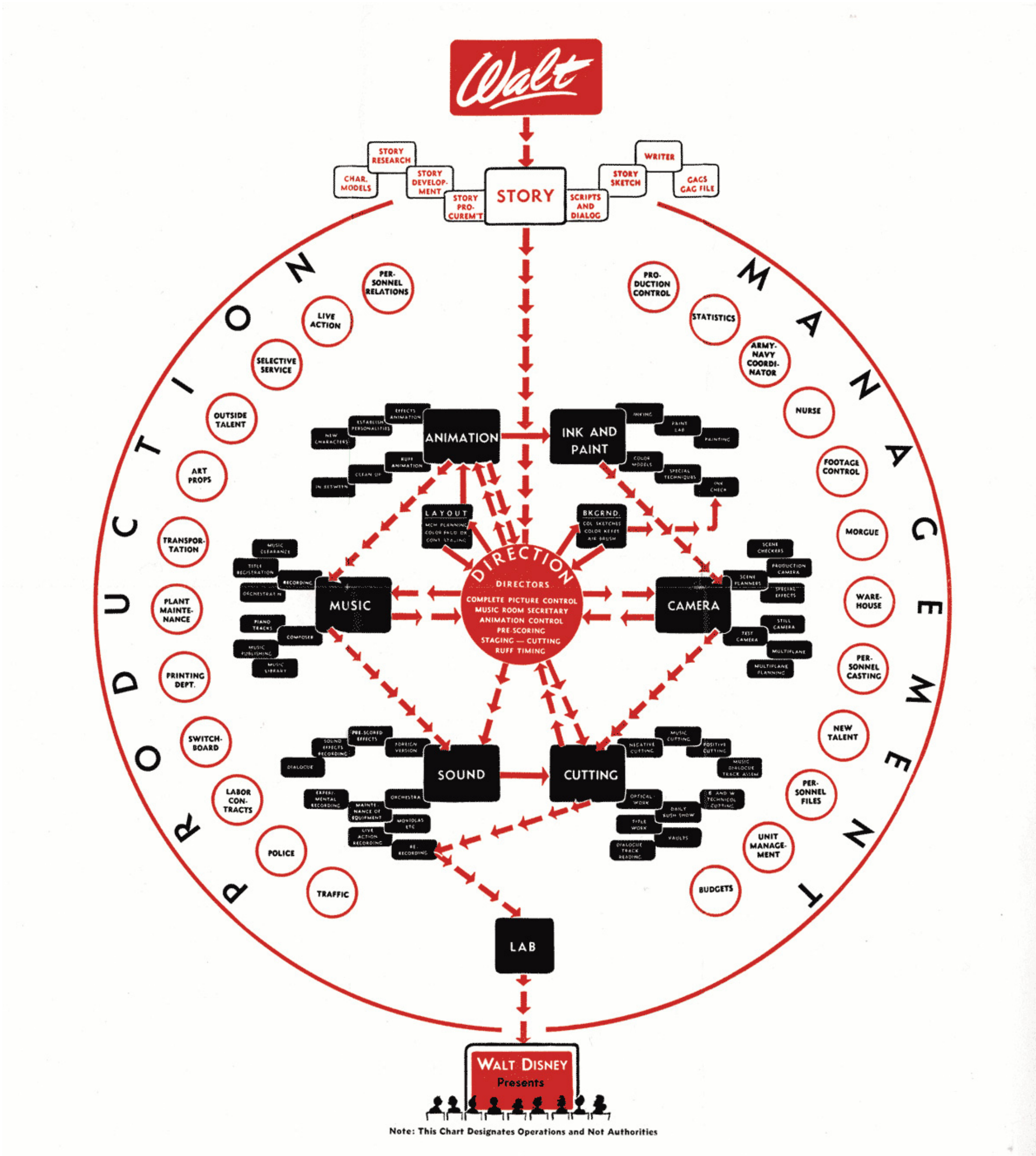

FIGURE 2-4 The Walt Disney Studios functional organizational chart of story realization from 1943. SOURCE: Walt Disney. © Disney Enterprises, Inc.

Five years after its founding and during the height of World War II, Walt Disney Studios released a functional organizational chart based on the storyboard process—bringing a story idea through production to the screen. Notably, Disney's model incorporates no hierarchy that breaks operating divisions into separate "silos." The chart also lacks a chain of command and authority. Instead, all staff positions serve to support a common work flow. The chart is well adapted to an idea-based process flow (see Figure 2-4).

This design option was inspired by these points in the discussion:

- Start with the story: it is critical. Scientific measurements, calculations, and numbers are less important than an emotional appeal in the initial stages.
- Fictional stories (e.g., the *Star Trek* television series, the movie *Minority Report*) have captured or perhaps even inspired a future to come.[7]
- "The best way to predict the future is to invent it" (Kay, 1989).
- When envisioning the future, innovators look to their desires and imagination. Forecasters should do the same.
- Writers of fiction are professional story generators who can make useful participants in the forecasting process.

The model shown in Figure 2-5 focuses on the development of narratives from broad themes or big questions. Using this as a central theme, a small set of potential scenarios is created that identify possible contexts for exploration. For example, from the broad theme of the future of medicine, one scenario might include widespread genetic profiling to screen and prevent disease and how this could lead to social challenges and create unanticipated consequences, while another would depict a world in which human augmentation could enhance health and physical and cognitive abilities.

Data relevant to those potential scenarios are then collected using both human- and machine-based methods. Next, the data undergo critical analysis by teams of scientific, technical, and political and economic experts who identify trends and form viable hypotheses, all of which are reported back to a story director. These hypotheses are applied to the initial scenarios to create output in the form of complete narratives that can be used in reports, demonstrations, and entertainment media. The model allows for persistence: themes that warrant further exploration can be extracted from the narratives and redeveloped repeatedly using the same process.

By beginning with scenarios and emphasizing narrative development, this model is intended to produce stories that include a compelling human element. In addition to providing emotional appeal, stories can be used to contextualize the everyday use of technologies that may not be in existence yet. For example, many of the technologies found in the television series *Star Trek* were "everyday" in this fictional universe decades before they appeared in real life. Captain Kirk's communicator allowed him to call for help from a planet surface to a starship in planetary orbit. A phaser beam weapon could be used in space to disable another vehicle or in the hand to disable an attacker. To be believable, these technological solutions had to convincingly address a human need. While this human element is a recognized necessity in successful entertainment media, it should be considered equally essential for eliciting action from stakeholders and policy makers who might otherwise have a lukewarm reaction to a potential threat that seemed too unlikely or abstract.

EVALUATION OF MODELS AND THE ACTIVITY

The committee evaluated the various models produced during the workshop exercises. From this activity, it was concluded that there is no one right way to build a next-generation forecasting system for disruptive technologies; each model has strengths and weaknesses. Table 2-4 paraphrases several workshop participants' assessments of the first three models. See Appendixes D and E for workshop transcripts.

Observation. There is more than one way to build a forecasting system; each model has different strengths and weaknesses.

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[7]It should be noted that many science-fiction-based technologies, such as faster-than-the-speed-of-light travel and teleportation, violate the known laws of physics. It is important to understand the required science behind such technologies when doing a forecast. In *The Physics of Star Trek,* Lawrence Krauss (1995) does an excellent job of looking at technologies proposed by *Star Trek* and the physics behind them. Employing roadmapping techniques such as backcasting to science-fiction technologies can help flush out what breakthroughs in scientific understanding must happen to enable a technology.

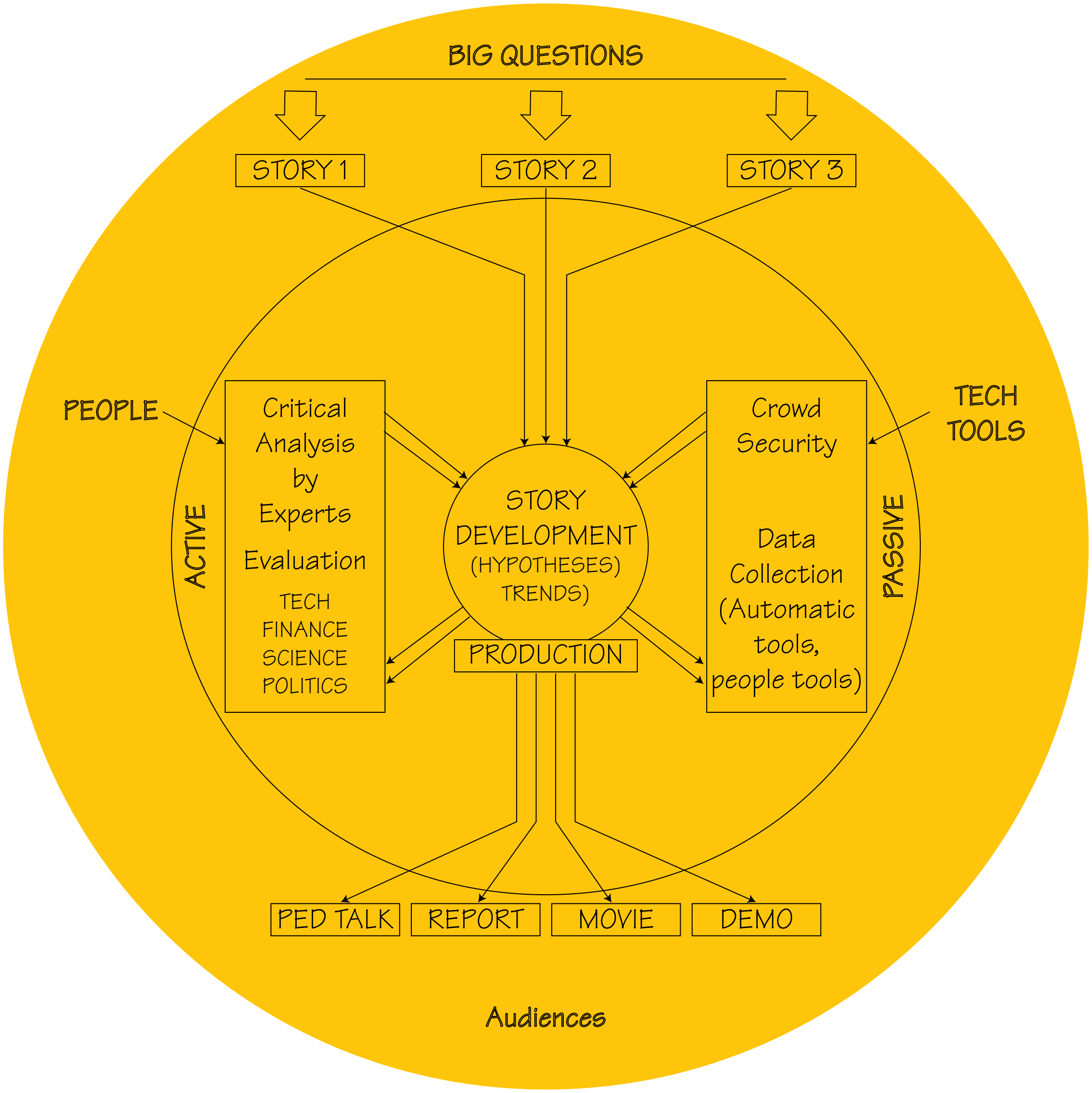

FIGURE 2-5 Storytelling Option. NOTE: The CD included in the back inside cover of this report has an enlargeable version of this figure, which is also reproduced in the PDF available at http://www.nap.edu/catalog.php?record_id=12834.

Recommendation 2-1. The 1.0 version of a forecasting system should employ the extensive passive and active data-gathering techniques employed in the Intelligence Cycle Option, using the data to develop roadmaps of potential futures with signals and signposts derived from data inputs (as seen in the Roadmapping Option). The end product of the system should include constant output and objective-driven output as described in the Crowd-sourced Option.

TABLE 2-4 Workshop Participants' Assessments of the Three System Design Options.

Participant	Option 1: Intelligence Cycle Option	Option 2: Roadmapping Option	Option 3: Crowdsourced Option
A	Perfect if you already have an organization following a structured approach such as the intelligence cycle.	A lot of assumptions made on data-processing technology that would be available. Good job on how the signposts were set up.	Web 2.0-influenced. Very open-facing, crowd-engaging way of doing analysis, inspiration-led way of doing analysis. How do you make it into a script? Organization concerns are very real for this. If you want global participation, there is a trust issue, so we must get the organization right the first time.
B			Would add this output array onto Option 1's, but keep Option 1's hypothesis engine and analysis.
C			We were clear on the inputs and outputs. Other groups did better on the middle part.
D	Inputs particularly well formulated. I would recommend theirs.	Good on changing narrative, how to do signposts.	Would like to add the hypothesis engine from Option 1 to this model. Particularly good way of thinking about outputs. Put these four output types with Option 1's inputs.
Others	Followed the intelligence cycle to a T. Learned something from that. Important attribute of that model is that it can be molded to fit existing organizations.	More challenges. Lots of assumptions about what the technology could do—crawling, scraping. Did a very good job thinking about how science is generated. Turn actionable thing into trap. Requires computer automation. Google approach to solve problem: Scrape sites, gather information, use some human analysis, but emphasize automated analysis. Take some accepted technology model from IGS, mass adoptions.	Lots of writing. Lots on inputs, going through process that produces very open engagement to do analysis. The circle is an inspiration-led way of how to do analysis and put pieces together to turn a big idea into a script or narrative, but believable. Useful way to look at it. Useful to have outside people come in. Good validation. Good ideas. Organization is the challenge. Requires a global organization. If it is not done right, it is not going to get the insights one is looking for because there will not be the right participation and continual participation.

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3

Analysis and Final Thoughts

Vision is not enough; it must be combined with venture. It is not enough to stare up to the step; we must step up the stairs.
—Vaclav Havel

Having outlined several frameworks that could be used to develop an operational version of an advanced forecasting system, the Committee on Forecasting Future Disruptive Technologies discussed further the challenges in building a next-generation forecasting system and what methods and actions would help ensure such a system's success. To that end, this chapter discusses the following: whether a next-generation persistent disruptive technology forecasting system can be built using existing technologies and methods, the features and characteristics of a next-generation forecasting system, and laying the foundation for subsequent steps.

CAN A NEXT-GENERATION PERSISTENT DISRUPTIVE TECHNOLOGY FORECASTING SYSTEM BE BUILT USING EXISTING TECHNOLOGIES AND METHODS?

For this second of its two reports, the committee was originally asked to evaluate the outputs of Signtific (previously called X2), a forecasting platform under development in conjunction with the Defense Intelligence Agency (DIA) and the Office of the Director of Defense Research and Engineering (DDR&E). A change in task occurred after the committee had received the outputs of Signtific and found them of no use in producing a forecast of potentially disruptive technologies. Specifically, the data were not detailed enough to allow the committee to refute or confirm its hypothesis that input generated from a younger generation of researchers, technologists, and entrepreneurs would produce different results from a traditional, expert-based forecast. The region and culture from which data points originated were also not recorded, and therefore the data could not be used to determine if different regions and cultures would forecast different technologies with different impacts than those in forecasts produced by Western experts. Overall, the limited data produced by methodologies employed by the Signtific team did not produce enough signals and signposts to track potentially disruptive technologies successfully.

Although the experience with Signtific highlighted some of the challenges of building a robust data set from innovative methodologies, it did not prove that a next-generation forecasting system cannot be built. The Forecasting Future Disruptive Technologies Workshop convened by the committee on November 5, 2009, gathered experts in the fields of commercial forecasting, software design, graphic user interfaces, and social networks. At the beginning of the day, the participants were asked if they thought that it would be possible to build a forecasting system with the key design criteria set forth in the committee's first report (NRC, 2010). The participants who commented all said that the managerial and technical obstacles to building such a system could be overcome. Even if faced with a system model in need of substantial development or change to be of use, the committee agreed that it would be in the best interest of the sponsor to continue efforts to build a next-generation forecasting system.

Observation. The illustrative models developed at the workshop indicate that the design and building of a 1.0 version persistent forecasting system for disruptive technologies are possible using existing technologies and forecasting methods and can be achieved within a reasonable time frame using a modest level of human and financial resources.

FEATURES OF A NEXT-GENERATION SYSTEM

Six Functions of the Version

Independent of the forecasting model used, a version 1.0 system for forecasting disruptive technologies should provide stakeholders and decision makers with a current forecast of potential futures and the potential disruptive technologies and impacts that would be the drivers of those futures as the current forecast applies to the stakeholders' and decision makers' domain of interest. A 1.0 system should contain six important functions: (1) needs definition, (2) collecting and developing alternative futures, (3) roadmapping, (4) engagement, (5) tracking, and (6) feedback. All four 1.0 options described in Chapter 2 incorporate these six important functions in their various approaches.

Needs Definition

The 1.0 system should provide a mechanism to help stakeholders clearly define their needs in order to maximize the utility of the forecast. Generally, a technology forecast starts with one or more high-level questions. For example: What will the U.S. energy needs look like in 20 years? What sources of energy will the United States rely on and what technologies are needed to exploit those sources? The questions generally include a description of the community (the United States) that is being affected, a time frame (20 years), a domain of interest (energy), and technological impact (exploitation of sources of energy). These questions should then be approached with an awareness of the stakeholders' perspective. For a persistent system, especially one that is used by more than one stakeholder, there is usually a method to collect "big, impactful" questions and a way for users, both experts and the crowd, to inspect and add to the collection. Sometimes these questions are categorized and ranked on the basis of a predetermined priority of needs or potential impact.

Collecting and Developing Alternative Futures

In a persistent system, forecasters, experts, and the crowd can hypothesize about alternative futures. An effective forecasting system should seek from these groups a broad range of alternative futures. This can be accomplished using traditional forecasting approaches (workshops, meetings, expert interviewers, polling) as well as newer approaches (Web-based collections, crowdsourcing, data mining, gaming, simulation, and prediction markets). These alternative futures should describe what the impact of disruptive change on the selected community might be, what preconditions would be necessary for the disruption to occur, which technologies might contribute to the disruptions, and what might be the source of the disruptive technology. These alternative forecasts should stimulate discussion and debate in addition to providing new ideas for alternative futures. A useful persistent system will capture the dialogue and discussions generated around these alternative futures. In some systems, users rank the likelihood of each alternative future; the committee believes that it is as important (if not more so) to rank the importance and impact of each alternative future.

Roadmapping

A useful forecast should show how each alternative future can evolve from the present. This is done in a process called roadmapping, in which experts look at each alternative future that is considered important enough for analysis and develop a roadmap of events between the present and the future. This roadmap can be used for tracking events as they occur, and it can also provide insight into the necessary conditions and technologies that would lead to a specific future.

Engagement

The version 1.0 system should provide a variety of tools to engage stakeholders and decision makers. These tools should include dashboards, lists, narratives, reports, videos, simulations, and gaming to help communicate to stakeholders and decision makers the range of alternative futures (what could happen), their potential impact (who is affected by what, and how), the likelihood (probability of occurrence) of that future, and the path (roadmap) from today to the future. These tools should help stakeholders and decision makers better understand the possible futures and make actionable decisions (regarding resource allocations, policy investment strategies, organizational structure, goals and strategic priorities, and so on).

Tracking

A version 1.0 system should collect and track new signals and compare them to the roadmap to detect early-warning signs of disruption. In addition to tracking technological advances, it should examine other forms of disruptive change (i.e., financial, social, governmental, environmental, and scientific).

Feedback

A version 1.0 system should have a mechanism that provides feedback to the system development team, allowing the spiral development of the system as new knowledge is gained from operating the system and as new capabilities and requirements are added.

In addition to the forecasting system's six primary functions, the skillful incorporation of narratives and the engagement of a broad audience through use of an open platform bring important enhancements to current data-gathering and analysis methods. These techniques will help to create a truly next-generation forecasting system.

The Use of Narrative to Initiate Analysis

In its first report, the committee used a traditional model of forecasting to postulate a process: "When forecasting a disruptive technology, forecasters should use reasoned analysis and seek expert advice to understand what are the required foundational technologies and tools to engineer a new innovation. Estimating the timing of disruptive technologies requires an understanding of the sequence and an estimation of the timing of the emergence of foundational technologies and enabling tools" (NRC, 2010, p. 15).

The participants of the November 2009 workshop commented that predicting the exact timing of the disruption was not critical. Instead, forecasters must understand the range of potential futures and paths that lead to predicted futures. One of the major observations of the workshop participants was the importance of looking not for technologies that would be disruptive but for compelling narratives of potential disruptive scenarios. After a scenario is defined, the technologies or other elements that need to converge to enable the disruption can be imagined. Importantly, scenarios do not have to be time-specific. They identify signposts to look for when gauging the likelihood of a particular disruption.

It is important that the narrative be emotionally powerful, projecting the extreme fears and aspirations of a society. To capture the aspirations of a society, it is important that it have regional representatives participate in the creation of these scenarios and in the development of their corresponding narratives. The committee believes

BOX 3-1
Narrative as Input and as Output

The following comments were made by participants at the November 5, 2009, Persistent Forecasting of Disruptive Technologies Workshop. The unedited workshop transcripts from which these comments are extracted are provided in full in Appendixes D and E on the CD included in the back inside cover of the report and in the PDF available at http://www.nap.edu/catalog.php?record_id+12834.

Output "I always tell my associates, 'Don't invest in any technology unless you saw it on *Star Trek* first [because] . . . if you can't find it somewhere in there, maybe it's not worth the investment.'

"Works of fiction or entertainment, movies, screenplay, television shows have to tell a compelling story about the human condition. In science fiction like *Star Trek,* people create technologies to solve problems in the story. The writers have to make up technology to provide a new option or opportunity.

"If you can't make . . . an interesting story about the human condition [from a technology], it'll probably never come true."

Input "The conversation we're having around narrative and stakeholders is . . . the most profound thing we've been talking about in part because the capabilities required to do that well are actually quite different than the capabilities for gathering information, collecting information, synthesizing information, . . . [scanning] what's going on out in the world from a technology and adaptation perspective. And then the ability to actually pull that together into a compelling, emotional narrative . . . in a language that stakeholders are going to understand so they actually take action and make decisions differently than they might otherwise, that's quite profound."

Output "I'd start with the narrative . . . and then derive evidence, then move my narrative as the evidence tends to persuade me or others in different directions."

"I think it was Norman who said do the narrative first and then fill in from behind. Maybe what we should be looking for are the long-term successful narrators . . . who weaves successful stories time after time after time that are technology built and how did they weave that? What was it about their thinking that captured that future-to-come in the basic technology?"

Input "Several of us in this room had the experience of helping to create the world for the film *Minority Report.* . . . One of the significant things about the film is how many times clips from that film are used to communicate new products, whether it's Microsoft's Table, new advertising systems, or new scanning recognition systems. . . . Why did it work? We had a group of remarkable experts in the room but what made it actually work was Spielberg put it in a human context. . . . Everyone remembers their own particular moment—the electronic newspaper or Tom Cruise chasing his eyeball down the ramp for the optical recognition system. It is the story in context that actually makes those technologies come to life and probably accelerated the development of the technologies.

that those who are most likely to be affected by a disruption will write the most powerful scenarios and narratives. The narratives created by these scenarios should be moving enough to catalyze change in policies and resource allocation while describing the necessary technologies and applications that would enable the projected events. See Box 3-1.

Observation. A disruptive technology forecasting system focuses on technological wildcards: innovations that have a low or unknown probability of development but, if developed, would have enormous impact.

Observation. Beginning the forecasting process with narratives of potential futures rather than starting with a list of potential technologies produces more useful insights into possible outcomes.

Recommendation 3-1. The 1.0 version of a forecasting system should begin developing a forecast of future events or conditions by constructing structured narratives describing disruptive impacts within a specific contextual framework related to particular technology use. It should then use backcasting to roadmap potentially disruptive technologies and the triggers that enable these technologies, and then iterate the mileposts for the narrative.

Narrative defines and constrains a problem. A customer might want to have an answer to a question like, What is the chance that in 10 or 15 years there will be a way to provide troop transport that does not depend on gasoline? The question sets a process in motion. Participants start thinking about potential futures, such as a future in which the Armed Forces are not dependent on petroleum-based fuels. The next step might be using backcasting to analyze which enablers would be used to reach this future. These enablers may or may not be related to technology. They might include changing the use case for an established technology, the regulatory environment, or market conditions (i.e., price of oil), or a shift in social attitudes, for example.

The narrative idea initiates a dynamic flow. From that narrative idea, analysts or participants generate hypotheses, map and define potential scenarios of enabling technologies that could bring that future to pass, analyze scenarios and technologies, and then iterate narratives and hypotheses with additional data. Nothing is thrown away. Scenarios are kept and roadmapped with the necessary innovations, breakthroughs, and “miracles” that they would require. Enabling technologies are identified, and thresholds, signposts, and tipping points are marked for tracking. The system needs to mark these indicators and constantly scan for them. The threads that originate from the main narrative are the start of a broader, richer collection of variations of the narrative, all of which are added to the database and form part of the process. The richness of the ongoing story that unfolds defines the measurements, signposts, and tipping points to monitor and track looking for a convergence of miracles—of technology, social change, or other factors. The emergent signals will dictate where the narrative goes. The participants of the workshop observed that there are currently no large databases in which such narratives can be stored, retrieved, and used. This type of functionality could increase the likelihood of building successful forecasts of disruptive technologies.

Observation. Many factors affect alternative futures, and it is important to understand that more than just technologies need to be tracked.

Observation. There are no dedicated forecasting repositories that can be queried for data organized in narratives—potential future scenarios, impacts of a scenario, or implications of a scenario should it happen.

Recommendation 3-2. The responsible organization should develop a repository of narratives of potential futures, organized both globally and by region, that include potential economic, technological, and societal impacts.

In a persistent system, the narratives can be continually iterated and new data can be fed back into the narrative lines to inform and change them. Inputs generate outputs that become additional inputs as the storyline is furthered and refined or modified on the basis of new emerging signals. Each narrative describes a single potential future and can be used to generate a roadmap of possible events between the present and that future. The roadmaps are published and then refined using an iterative process of generating new narratives and generating updated roadmaps based on new signals and new scenarios. A useful output to the user would be to list the highest-impact narrative(s) along with descriptions of enabling technologies, and what conditions occur for the narrative to unfold. Integral to the impact of the technology is the context in which it is used and how it is used.

The use case for the technology is an important part of the narrative scenario. Unconventional uses of existing technology can provide disruptive effects as readily as new technology can. Use cases are a function of using technology to solve issues faced by society or by a particular group of people. The context of that group—its

BOX 3-2
Gearing Up and Gearing Down

The following are examples of forecasting narratives that might be generated to either gear up or gear down technology:

- *Gear down:* Stefan Sparrow, an unemployed Ukrainian dockworker, designs a system using a remotely controlled car and vodka that he then uses to start a string of attacks on shops across Europe.
- *Gear up:* George Goose, a disgruntled postdoctoral student in the midwestern United States, uses cheap based-pair replication technology and an understanding of plants to design weeds that are resistant to current herbicides. He releases them into the wild, causing economic damage throughout the Midwest.

values, ideas, needs, pressures, worldview, economics, culture, and traditions—influences the uses to which it might apply a technology.

Technology can be "geared up" or "geared down." To gear down is to use lower-level or earlier technologies to solve problems (see Box 3-2). In the science-fiction series that starts with the book *1632* by Eric Flint (2000), a modern community in West Virginia is transferred (through a criminal act of artistic negligence by a futuristic society) to Germany in the year 1632, during the bloody Thirty Years War. To adapt, the community must gear down to technologies that can be supported in more primitive conditions.

Following is a real-world example of gearing down: The Irish Republican Army in the 1970s devised home-made bombs using agricultural fertilizer; Semtex, a plastic explosive; and "shipyard confetti" (metal waste found in the shipyards of Belfast) for shrapnel in guerilla warfare against the British Army. These improvised explosive devices (IEDs), also known as roadside bombs, typically consist of an explosive charge (potentially assisted by a booster charge), a detonator, and a mechanism that initiates the electrical charge that sets off the device. IED designs are very flexible, using a diverse set of available materials to devise initiators, detonators, penetrators, and explosive loads.

There is danger in the human psychological inability to deal with ambiguity and potentially shocking scenarios. The use of commercial airlines as weapons was contemplated by both the intelligence community and novelist Tom Clancy years before September 11, 2001, but no forecasting system was in place to track enabling factors or traffic that would have indicated activity along this narrative path (e.g., students taking flying lessons to learn how to take off but not to land an aircraft). A narrative incorporating a strong use case would be a valuable tool in convincing stakeholders of the possibility of the extreme scenarios that a disruptive forecasting system is designed to help foresee.

Using an Open Platform for the System

Another important element reinforced in the implementation exercise for this report was that workshop participants considered openness to be critical for obtaining a diversity of inputs. The success of the system in uncovering potentially disruptive technologies relies on the inclusion of participants with various levels of education and from various cultures, classes, races, and age groups. Making this system a more open platform is a fundamental shift from traditional Department of Defense (DoD) forecasting. Many of the participants believed that the system should be open in every way—that it should have open analysis, open participation, an open loop, and open platform products that include live interactions. There could be parallel closed loops[1] for different users. For example, if a forecast involved classified information about nuclear weapons development, a closed system could be run on a classified network with strong access controls for cleared personnel only. The beauty of open-platform design is that it is aligned with the explosion of Internet applications and social networking media development. It would be critical to have participation be international, sourced regionally in the local language. Asking a native Chinese-speaking participant a question in Chinese could elicit an answer different from that received when asking the question in English due to changes in the participant's comfort level, perception of the question, understanding of the question's meaning, or ability to use nuance. Fundamentally, soliciting participation across languages provides access to different points of view. For classified forecasts, the committee believes that a similar system could be built that could be used with a broad range of cleared participants.

Observation. It is critical to the success of any forecasting system to engage members of different cultures in their native languages and in a familiar environment in order to reduce bias.

The system could be used as the equivalent of the wiki (collaborative Web site database) on best-in-class representation of science and technology, a virtual portal on science and technology narratives of the future openly contributed to, participated in, and drawn from. The membership would include those who are passionate about the future of science as input to policy and postdoctoral students hungry for other venues in which to apply their skills. If the outputs of the system are truly useful, they will provide the incentive for participation. The users might include planning departments and venture capitalists.

Observation. A persistent forecasting system can be built to serve many different customers, providing a continuously active and current forecast for users.

Observation. An open-platform forecasting system could generate a great deal of interest from corporate and other international users.

Observation. A number of organizations are currently working on a next-generation forecasting system. Early efforts by corporations such as IBM, SunEdison, and Shell should be closely tracked for insights and possible partnerships.

To be successful, those setting up the persistent forecasting system would have to work hard to balance Western bias against a wider worldview. This is explored in more detail in Chapter 4 of the first report (NRC, 2010). The system would have to be cross-cultural, multidisciplinary, and multigenerational. It would have to reflect a wide range of viewpoints of people, including those on the fringes of their societies. A challenge would be to include regions and classes that have little or no Internet access but might well be important for establishing their values, needs, and unique applications of lower-level or older technologies. The system set would also have to work to balance any DoD biases. The committee believes that too much government control would impede the ability to get broad participation and sponsorship. Separation of the internal and external teams could help bring together the best talents and capabilities of government and industry (see Recommendation 3-8).

The operational challenges presented by an open forecasting system were discussed in depth by the participants of the workshop. Consideration was given to several options, including a crowdsourcing approach to generate and collect data, ideas, and hypotheses, combined with expert analysis of the information. Another option limited the level of openness by inviting a large group of experts to produce forecasts, but with a far broader range of expert participation than in a typical Delphi forecast. The outcome of the evaluation of the various options centered on the concept of separate, interacting systems of open participation and closed use, with output fed back into the system to create a persistent loop. It was agreed on by the participants of the workshop that openness can be more

[1]Closed-loop systems are more restrictive and could require prequalifications, including appropriate credentialing, before users were admitted.

easily incorporated using Web-based technologies and applications, but that Web-based technologies are not a total solution in that a truly inclusive system would also engage people with little or no online access. Also, incentives to participate will be an important part of setting up an open forecasting system.

CHARACTERISTICS OF A NEXT-GENERATION FORECASTING SYSTEM

While all of the models outlined in Chapter 2 had the essential elements discussed previously in this chapter, the desired characteristics for the next-generation forecasting system will need to be defined both for the 1.0 system and for future spirals of development of the persistent forecasting system. Suggested characteristics include mechanisms for continual learning, success metrics for participation, and success metrics for outputs.

Building Learning into the System

The forecasting system for disruptive technologies needs to be designed for ongoing evolution to improve methodologies in all areas of sourcing, analyzing, and producing searches. While the frameworks outlined by the committee should work, metrics are needed to define success and guide forward progress and direction of growth. A learning system involves analyzing success against metrics for success to see what elements are enhancing the system and what might be lacking. Data in the system would be segmented so that different parameters could be measured—for example, whether contributions from different regions added insights more predictive of futuristic trends than did inputs from within the United States. The value of different inputs, contributions by different communities, or different methods can be evaluated and adapted. If a model like interactive gaming seems to result in future visualizations, it could be used more extensively. If indicators show up in communities that are not currently participating in the crowdsourcing, those communities can be invited to participate. If types of data are needed for analysis, ways to find or track the data can be devised or built.

Recommendation 3-3. The forecasting system for disruptive technologies needs to be a learning system in which midprocess system products are continually evaluated and used to refine concepts and methods, and final outputs can be collected and compared over the long term to evaluate system processes and build expertise among staff. The first version of the system should be thought of as a version 1.0, with the recognition that it may take successive phases of development to create a sustainable and useful platform.

Success Metrics for Participation

Early measures of success with respect to participation would include the establishment of a community that draws broad participation and attracts funding for the value of its outputs, which consist in part of the input of participants. One effect of engaged participation might be to train the next generation of forecasters and potential decision makers on a new way to produce and use technology forecasts. If corporations use the system, it is indicative of the value of the output. The success of the participation can be measured in terms of the following:

- Global participation;
- The quality and frequency of engagement, the quality of conversation or content, recurring subscribers;
- Engagement with contrast, polarity, heat, conflict, and potential controversy;
- Level of interest, community ranking;
- Diversity of user population in terms of age groups, ethnicities, professions, and socioeconomic status;
- External funding, receipt of grants;
- The number of unsolicited narratives that meet criteria;
- An improvement in the quality of forecasts over existing forecasts, unique and compelling forecasts that are truly disruptive narratives from the fringes of possibility;
- The use of roadmaps that can be evaluated by users, rather than the use of predictions;

- The education of policy makers to be more comfortable with how to navigate uncertainty and create advantages; and
- The attraction of strategic partners.

The process is working when the system does the following:

- Generates both scenarios and potential technologies that are different from the baseline;
- Reduces unusual insights and potential insights into the impact of the technology;
- Anticipates new applications of technology;
- Tracks signposts and signals as to whether they will make a difference;
- Awards recognition to participants to drive more forecasts;
- Produces novelty of narrative but also the breadth that encompasses silos, subjects, and disciplines that are affected by the proposed scenarios;
- Identifies signals and signposts for tracking and putting data into context;
- Identifies triggering or threshold data points to warn of potential conjunctions of events and to indicate that an event is becoming more probable; and
- Produces actionable forecasts that support decision making, resource allocations, and scenario generation.

The more high-level topics that a narrative hits the more interesting it is and the more likely that a conjunction of events will occur.

Success Metrics for Outputs

The forecasting system should produce high-quality information that includes high-impact scenarios, critical enabling criteria, scientific trends, trends in the signposts, and the representation of the environment of interest. If the forecasting system works, it should increase ambiguity and uncertainty and stimulate more questions and studies—one caveat being that ideas that challenge existing knowledge or touch on forbidden subjects may be uncomfortable to some audiences. People are more comfortable with known risks than with unknown risk. There needs to be some insulation between uninhibited inputs and analysis and the evaluation of the usefulness of the outcome. Every narrative generated needs to be plausible but not necessarily probable. To be useful, narratives of potentially disruptive events are more likely to be in the improbable category. They do not have to be right. They would be valuable for opening possibilities in people's thinking, anticipating disruptive scenarios, and providing a useful framework for tracking the development of disruptive technologies.

Observation. Not every narrative needs to become a reality. In fact, it is an indicator of system failure if all narratives come to pass. Narratives must pass a minimal test of probability and plausibility, but otherwise it is essential that the collection of narratives push the edge of probability and believability. Focusing on narratives that are highly aspirational or horrifying could stimulate discussion of extreme scenarios that could have the greatest impact on the forecasting system.

Recommendation 3-4. Any forecasting system developed should be insulated to allow users to generate and investigate controversial or uncomfortable ideas. Participants and staff should identify the reasons that an idea is considered implausible and be able to understand what developments will be needed to arrive at that future. These developments should become signposts on the roadmap of the forecast.

Another measure of success would be the effect that public use of content from the system has on the real world, if a user or participant uses a scenario in the public domain to influence an action or decision. Longer-term success might be measured in terms of whether the outputs of the system affect policy, engagement with Congress, new technology concepts, or new applications of technology. Forecasting needs to change behavior to be successful. The outputs must be structured to communicate to the user that the narrative is possible and the forecast is actionable. The information should be presented in a way that is compelling, inspires action before the fact, and convinces people of the usefulness of the forecast.

The forecast generated from the system must be usable and informative to the user. The output of the system is less about technology than about technology impact and use and about what applications could be enabled with the technology. The structure of the final narrative would describe the impact of a confluence of technologies, events, and creativity and describe how the scenario was arrived at. The presentation should make the case for the evidence that these events would be enabling and lay out the measurements of interest to monitor and the signpost and tipping points to watch for to indicate that a scenario might be coming true. What are the trends in the signposts?

Success measures for the output of the system include the following:

- It demonstrates how a scenario affects people's lives, how the scenario is a doable future;
- It generates actionable outputs (the information is used);
- It receives positive feedback from potential customers;
- It generates value (might be intellectual, literary, as well as for future planning);
- It has information incorporated into other organizations' analyses, reverse citation;
- It trains future policy leaders in the effective use of technology forecasts;
- It causes new policies to be generated;
- It survives: the system continues;
- It improves the ability of decision makers to continuously ask the right questions; and
- It reduces surprise.

Observation. Users of a forecast must have confidence in the quality of the underlying data and the analysis that led to the forecast. Measures that reinforce confidence include data transparency and the availability of multiple expert views. Success is measured not by how many accurate predictions are made but by the value of the insights and what actions were generated to reduce negative surprises.

With a persistent, open-source, narrative-driven system, it is possible to look at a broader picture of potential disruptions. With a repository for findings, possible scenarios, narratives, and every question asked of the system, it is possible to ask the right questions persistently until it is asked at the right time. It is possible to revisit scenarios with new data, to put pieces together differently, to mark which scenarios seem to keep coming up.

The system process is a broad radar. The narrative outputs can be more targeted for specific action and tracking. But the system could become more than just a forecasting system for future technologies. If successful, it could be an interactive platform that could be used to generate new concepts, a source that allowed people to flesh out and flush out ideas. It could provide data about how things impact other people around the world. How the system is set up will be critical for creating that dialogue and fueling narrative generation, some of which will become focused targets.

Recommendation 3-5. The forecasting teams should develop metrics of performance (i.e., for valuing and synthesizing) so that the process can be controlled, optimized, and improved.

LAYING A FOUNDATION FOR SUBSEQUENT STEPS

The day after the workshop, the committee met in private to discuss the results of the model-building exercises and discussions and to combine these results with the work of the entire project life span to project a set of actionable recommendations that might benefit the sponsors. Out of the four proposed models, certain elements were distilled into specific guidelines, which are described in detail in this section.

First, the committee strongly agreed that the human resource is key in making the proposed forecasting system work. There will have to be a careful alignment of purpose, technology, participants, and resources to create an optimally successful system.

Recommendation 3-6. The Department of Defense and the intelligence community should begin the process of building a persistent forecasting system by selecting leadership and a small, independent, development team. The team should be given seed-level funding to establish an organizational structure and business plan and build a working 1.0 version of a disruptive technology forecasting system. The organization should have to attract additional funds from domestic and foreign corporate, nonprofit, or government sources.

Structural Options

The range of options for the organizational structure presents a question of governance. Determining the governing structure is outside the scope of the committee's task, but the committee looked at some of the questions that would need to be answered. A small, motivated, start-up group of people would have to be responsible for refining the methodology, determining who the participants are and how to provide incentives to motivate them, identifying what partners to seek out, and creating a business plan. The start-up group should consider asking itself some fundamental questions such as the following:

- If there is an outside and an internal group, what is the synergism between the two?
- What are the pros and cons of the various options and possible barriers?
- What are examples of successful groups using various models (e.g., public-private partnerships such as Sematech and In-Q-Tel)?
- How will the structure impact participation, governance, and funding?
- How does an organization develop a persistent business model that matches its persistent forecasting mission?

Recommendation 3-7. The Department of Defense and the intelligence community should consider using a separate, independent, multinational, multidisciplinary nonprofit or dot-org group to run the crowdsourced platform. The organization should be structured correctly from the beginning to ensure trust and good working relationships among staff. The crowdsourced platform should have its own separate governance with leadership representing multiple ethnicities and disciplines.

As stated in Chapter 1 in this report, the workshop participants suggested that the organization of the open-platform system needs to be separate from the organization inside the DoD that would deal with evolving scenario information on a classified basis. This thought of two systems and the importance of not having bias was discussed in detail in the first report (NRC, 2010). The team inside the DoD would be independent but would collaborate with the external organization.

Recommendation 3-8. A forecasting system should have two separate teams, one team working on the open external forecasting platform and another team developing an internal forecasting platform that services specific needs of an organization. The external team should encourage broad and open participation and exchange of ideas and scenarios from a broad range of participants and experts. The internal forecasting platform should address scenarios that are specific to the organization and may involve sensitive, proprietary, or classified scenarios and data that it is only willing to share with trusted parties.

In the case of the Department of Defense, there are a number of possibilities for how to structure this arrangement: a joint venture between the government and a private entity, a joint project with another intelligence organization, partnership with an analytical institute, a contract with an existing forecasting group, a request to the National Science Foundation to sponsor it, a consortium, the creation of an independent nonprofit organization, the establishment of a research organization entirely outside of government such as a multidisciplinary university research initiative (MURI) at a university, a program sponsored by the Defense Advanced Research Projects Agency, or some unconventional approach. In the Institute for Analysis partnership with the DoD, the Institute is the external face, so it can do many things that the DoD cannot. Another possibility would be partnering with a museum or network of museums that backcasts using science and technology. For the DoD user, the outside organization broadens its reach and vision. Connecting with academic, research, and commercial communities would be an early success for the DoD user that would improve on using stovepiped lists of emerging technologies. The DoD can subscribe as a shadow organization through the open platform.

The concept of a crowdsourced community for forecasting in itself is disruptive. On the one hand, the bipolar nature of the concept is that some of the hypotheses being generated could be about how to disrupt the United States or about the discovery of highly disruptive technologies that could radically change the world, and that these hypotheses would be discussed in public forums. A private partnership might be a way to mitigate some of that effect. On the other hand, the crowdsource is an opportunity to force a level of accountability on decision makers to deal with and prepare for highly disruptive scenarios.

There are several ways to get the system organized. One way would be to have a sponsor's internal staff work with trusted external contractors to find the necessary people to form a start-up committee, similar to the way that In-Q-Tel was organized. A second way would be to find one person who would be the organizing chief and let that person find the start-up committee. Finally, a third way would be to put out a broad area request for proposals and then allow the winning proposal to form the start-up committee.

The start-up committee would have to define the structure for the persistent system, with recommendations for how to interface with whatever user organizations participated in the open platform and how those organizations might use the output for future planning. The relationship between organizations would need to be defined. Would staff of the open system simply maintain the system and allow the work product to be solely open-source-derived, or would the staff "add value" by doing analysis and generating internal narratives, hypotheses, needs, technology, and uses that run parallel to the crowdsourcing process? The participants of the workshop believe that the advantage of this crowdsourcing, persistent approach is the use of an iterative process in which new ideas and forecasts are generated through crowdsourcing and live data-gathering activities, followed by concept refinement performed by experts. This balance will have to be worked out. The strengths of other analytical methodologies can be used to complement the strengths of a crowdsource system.

There might be a need to define a particular structure or structural interfaces for user organizations. Demographic information might be required for participation. Regardless of who the members are, they will have their own internal mechanisms for reacting and responding to the open system. The outside groups might generate ideas, but the inside groups will have to decide what is relevant to them, redesign and interpret narratives for their own purposes, and put them back into the system as inputs. The start-up committee would need to consider sustainability in the structure for a persistent system that should be able to keep going without being shut down by any one participant. The structure of the narratives has been referred to often in this report, but it might be useful to design a format for narrative. The start-up committee might decide to backcast data to test for verifying and validating and refining the methodology.

The start-up committee would have to be clear about the following:

- Who the initial sponsor(s) would be,
- What the sponsor(s) want and how they will be educated about what they will get from the system,
- The expected time frame to build version 1.0,
- Measures of success for performance and metrics for signaling refresh, and
- An investment plan and the discipline to carry it out: a large budget will be insufficient if not well implemented.

Resources

The initial development team should be small and carefully selected to ensure that the members work with the efficiency and flexibility needed to successfully develop a complex software system with limited resources. The team leader catalyzes both the forecasting process and the development of the system. He or she should head a core team of up to 12 subject-matter experts to guide analysis.

The estimated software application requirements will be defined or designed and given cost estimates. The participants of the workshop and the committee members believe that the cost of the effort, including building the 1.0 version and the ongoing maintenance of the system, would be between $5 million and $10 million. The team would be responsible for managing the initial seed funding of $1 million to $2 million and promoting the system to other potential users and investors to attract the additional funds needed for the long term. See Recommendation 3-6.

How the System Might Be Implemented

After completing the model-creation exercise and reviewing the work of the three workshop subgroups and Stan Vonog's proposed fourth option, the committee discussed a common vision of what a forecasting system would entail and the experience that it would provide to the user.

A user can either post or select a narrative to follow. The user can rate the hypothesis generated from the narrative (the equivalent of Facebook's user rating "likes this" but with numbers) or join a discussion thread that contributes posts, which are flagged as technologies, uses, progression, or synthesis. This input is used to help flesh out the signals, signposts, enabling technologies, or whatever else is needed for a scenario to be realized and to identify potential intended or unintended "off label" uses and outcomes. The final step is writing, reading, rating, and commenting on output narratives and impacts.

Identified needs, technologies, or narratives are evaluated during process analysis, both for their potential importance and for their "oddness," or distance from mainstream sources of innovation. The desired area of focus is on the outliers in a normal distribution curve of likely emerging technologies, or on an abnormal distribution. Distribution analysis could be applied by demographic groups, and concordance between groups could be estimated with confidence intervals. This moves toward convergence and divergence and identification of "heretics." Once rated, entries of interest can be used to look for their uniqueness or recurrence/convergence in the system using an algorithm similar to those employed by plagiarism-detection software, which would tabulate the repeated ideas and associated demographic data. The level of automation of this system could be quite complex, with high and low thresholds of perceived importance selecting the text to be run through the convergence/divergence engine. The system could also use a timed process to run previously identified topics periodically to see if new inputs change the analysis of previous dated inputs. This process could be mirrored by the organization's internal staff as allowed by the organization's structure and mandate.

It is equally important to separate the geniuses and heretics from the charlatans and the "crazies." This is especially true when a system relies on crowdsourced information. One approach is to use experts to roadmap scenarios through techniques such as backcasting to see how an alternative future can unfold. These roadmaps should be checked to see that they do not violate a specific law of physics. Only scenarios that can be roadmapped should be considered actionable. Relevant scenarios should be reviewed again if there is a significant breakthrough in science that might make possible an outcome previously assumed to be impossible. These scenarios should then be roadmapped on the basis of new knowledge.

As the committee discussed, a rating scheme built into the system would allow at each stage of the process for peer evaluation that can be fed back into the system. The danger is a ranking or rating system that starts to bias the input, intimidate users, or alter the direction in the building of the narratives. It might be possible to rank the value of a particular user's contribution without creating a situation of "voting" on the most popular outcome. That would be the wrong bias on output. It might be necessary to designate some information for internal use only in order to avoid bias but still to have data needed for analysis.

To have the quantifiable and research-enabling inclusion of a diverse user community, the system might collect demographic data when a user opens an account. The data should include country (and possibly country of birth or upbringing), age, economic level, educational level, field, and level of expertise in that field. Contributing groups might have a consensus level of expertise. If demographic data are identified, it will be possible to measure the difference in value ranking of narratives coming from U.S. residents in comparison to non-U.S. residents, as well as to measure other important demographic distinctions. See Table 3-1.

TABLE 3-1 User Demographic Information: Examples of Useful Participant Demographic Data

Demographic Data	Description
Country	Of origin, raised in, citizen of, current residence, secondary residence
Economic level (annual income range)	Keyed by country to match five income levels: low, low-middle, middle, middle-high, high
Educational level	No school, primary school, high school, years of college, advanced degrees, doctorate
Field, level of expertise	Expert in field (field), generalist (fields), lay person (fields of interest). Labeling could vary for different fields.

Goals for Version 1.0

To ensure a robust foundation for a persistent forecasting system, version 1.0 should have seven fundamental goals:

1. Broad international and regional participation;
2. A broad range of future scenarios, including many improbable but possible alternative futures;
3. The narratives that tell compelling stories, highlighting the impact on society;
4. Backcasts developed by experts with credibility in their respective fields;
5. Robust and actionable roadmaps that illustrate how the present can develop into a potential future, indicating potential signposts, important observable signals, and tipping points;
6. The use of roadmaps for the ongoing tracking of disruptive technologies; and
7. The use of the forecasting platform by entities other than the U.S. federal government, including other governments, corporations, and organizations.

These goals should be reviewed regularly during both the development phase and deployment phase of version 1.0. The forecasting team should also develop midcourse evaluations and make midcourse corrections based on the ability of 1.0 to achieve these goals.

CONCLUSION

Forming a successful forecasting system for disruptive technologies is a task with several inherent challenges that are both a direct result of the new explosion of information exchange brought about by the ubiquity of the Internet and suggested solutions to the challenges posed by it. High-quality data must be collected in quantity, organized, and contextualized to be made meaningful. As demonstrated by the work performed at the Forecasting Future Disruptive Technologies Workshop and previously by the committee, there are many different strategies that can be used to meet this goal. This hitherto mostly uncharted territory should be approached with an open mind, a willingness to adapt, and confidence.

Recommendation 3-9. A persistent disruptive forecasting system should be built to help the intelligence community reduce the risk of being blindsided by disruptive technologies.

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Appendixes

Appendix A

Biographical Sketches of Committee Members

Gilman G. Louie, *Chair,* is a partner of Alsop Louie Partners, a venture capital company. Mr. Louie is a former president and chief executive officer (CEO) of In-Q-Tel, the venture capital group helping to deliver new technologies to the Central Intelligence Agency (CIA) and the intelligence community. Before helping found In-Q-Tel, Mr. Louie served as Hasbro Interactive's chief creative officer and as general manager of the Games.com group, where he was responsible for creating and implementing the business plan for Hasbro's Internet games site. Before joining Hasbro, he served as chief executive of the Nexa Corporation; Sphere, Inc.; and Spectrum HoloByte, Inc. As a pioneer in the interactive entertainment industry, Mr. Louie has had successes including the Falcon, the F-16 flight simulator, and Tetris, which he brought over from the Soviet Union. He has served on the boards of directors of Wizards of the Coast, the Total Entertainment Network, Direct Language, Ribbit, and FASA Interactive. He currently serves as a member of the technical advisory group of the Senate Select Committee for Intelligence and was an active member of the Markle Foundation Task Force on National Security and the Information Age.

Prithwish Basu is a senior scientist in the Network Research Group at BBN Technologies in Cambridge, Massachusetts. He is the principal investigator at BBN on multiple networking programs funded by the U.S. Army Research Laboratory, namely, the Collaborative Technology Alliance and the U.S./U.K. International Technology Alliance. He is also the chief architect at BBN on the Defense Advanced Research Projects Agency's Disruption-Tolerant Networking program. In 2006 he was named to the Massachusetts Institute of Technology (MIT) *Technology Review*'s list of Top Innovators Under 35 . Dr. Basu's current research interests include theoretical as well as practical aspects of disruption-tolerant networking; energy-efficient medium access control, routing, and synchronization in wireless ad hoc and sensor networks; and robot networking. Recently he has also been interested in network science and is also exploring the use of biological metaphors for developing new networking algorithms. He received a B.Tech. in computer science and engineering from the Indian Institute of Technology in Delhi and M.S. (1999) and Ph.D. (2003) degrees in computer engineering from Boston University. Dr. Basu has co-authored more than 30 conference and journal articles and 2 invited book chapters and has two patents pending. He is a senior member of the Institute of Electrical and Electronics Engineers (IEEE), the Association for Computing Machinery, and Sigma Xi and has served on the technical program committees and organizing committees of several leading networking conferences such as IEEE INFOCOM.

Harry Blount is currently the founder and CEO of DISCERN. Mr. Blount is chair of the Futures Committee for the Tech Museum of Innovation and is chair of the Advisory Committee for Alpha Theory (www.alphatheory.com), a portfolio management software company. He served on the board of directors of Lefthand Networks until the time of its purchase by Hewlett-Packard in November 2008. Mr. Blount spent 21 years on Wall Street, most recently with Lehman Brothers, where he was a leading analyst in multiple consumer and enterprise technology disciplines, including the Internet, wireless networks, personal computers, servers, storage, hard drives, telecommunications, information technology distribution, environmental services, and convertible securities. His weekly publication, *In Blount Terms,* was widely read by technology investors and executives. Prior to working at Lehman Brothers, which he left in November 2007, Mr. Blount had worked at a variety of firms, including Credit Suisse First Boston, Donaldson Lufkin and Jenrette, and CIBC Oppenheimer. Mr. Blount was named an All-American in Information Technology Hardware and Internet Infrastructure Services by *Institutional Investor* magazine. He was also recognized as a *Wall Street Journal* All-Star for Computer Hardware. From 2002 to 2006, while at Lehman Brothers, Mr. Blount served as an outside adviser to Nokia Innovent, a Nokia Ventures Organization company. Innovent evaluated emerging technologies for the digital home and data center. Mr. Blount has spoken at numerous events, including Storage Visions, IDEMA (the Hard Disk Drive Industry Association), the Digital Home Developers Conference, and the Global Technology Distribution Council conference, and at internal management events at some of the world's leading technology companies. He has appeared frequently on CNBC and the *Bloomberg Report* and has been quoted in numerous publications, including the *Wall Street Journal, Barrons, Forbes, Fortune*, and *Business Week*. Mr. Blount is a chartered financial analyst. He earned a bachelor's degree in finance from the University of Wisconsin at La Crosse in 1986.

Ruth A. David (NAE) is the president and chief executive officer of ANSER, an independent, not-for-profit, public service research institution that provides research and analytic support on national and transnational issues. In April 2004, ANSER was selected by the Department of Homeland Security to establish and operate a new federally funded research and development center, the Homeland Security Institute. From September 1995 to September 1998, Dr. David was the deputy director for science and technology at the CIA. As technical adviser to the Director of Central Intelligence, she was responsible for research, development, and deployment of technologies in support of all phases of the intelligence process. She represented the CIA on numerous national committees and advisory bodies, including the National Science and Technology Council and the Committee on National Security. Previously, Dr. David had served in several leadership positions at the Sandia National Laboratories, where she began her professional career in 1975. Most recently, she was the director of advanced information technologies. From 1991 to 1994, Dr. David was director of the Development Testing Center that developed and operated a broad spectrum of full-scale engineering test facilities. Dr. David has also been an adjunct professor at the University of New Mexico. She has technical experience in digital and microprocessor-based system design, digital signal analysis, adaptive signal analysis, and system integration. Dr. David is a member of the Department of Homeland Security Advisory Council, and the Corporation for the Charles Stark Draper Laboratory, Inc. She is the chair of the National Research Council (NRC) Committee on Technology Insight—Gauge, Evaluate, and Review and the vice chair of the Homeland Security Advisory Council Senior Advisory Committee of Academia and Policy Research. Dr. David received a B.S. degree in electrical engineering from Wichita State University and an M.S. and a Ph.D. degree in electrical engineering from Stanford University.

Stephen W. Drew (NAE) holds consultancies with a variety of pharmaceutical and biotechnology organizations and is a founder and principle of Science Partners LLC. Until 2000, he worked with Merck and Company, Inc., in a series of increasingly responsible positions, culminating with distinguished senior scientist. He held vice presidential positions including vice president of Vaccine Science and Technology, vice president of Vaccine Operations, and vice president of Technical Operations and Engineering. Prior to joining Merck Manufacturing Division in 1987, he was the senior director of Biochemical Engineering in the Merck Research Laboratories, a department that he started in 1981. Dr. Drew received his Ph.D. in biochemical engineering from the Massachusetts Institute of Technology. A member of the National Academy of Engineering (NAE), he has served in several capacities within the NAE and assisted numerous National Research Council committees. He was chair of the advisory committee to the Engineering Directorate of the National Science Foundation.

Michele Gelfand is a professor of organizational psychology at the University of Maryland, College Park. Her research interests include cross-cultural social/organizational psychology; cultural influences on conflict, negotiation, justice, revenge, and leadership; discrimination and sexual harassment; and theory and method in assessing aspects of culture (individualism-collectivism; cultural tightness-looseness). She received her Ph.D. from the University of Illinois at Urbana-Champaign in 1996 and has been published in many top journals, including the *Academy of Management Review, Academy of Management Journal, Journal of Applied Psychology, Journal of Personality and Social Psychology,* and *Organizational Behavior and Human Decision Processes.* She also recently co-authored with Miriam Erez and Zeynep Aycan a chapter on cross-cultural organizational behavior published in the *Annual Review of Psychology*.

Danny Gray previously served as a National Institutes of Health (NIH) postdoctoral fellow in the Department of Biomedical Engineering at Case Western Reserve University, being funded by a hematology/oncology training grant through the Case Comprehensive Cancer Center. Dr. Gray previously trained as a research fellow in the Division of Molecular and Vascular Medicine, Beth Israel Deaconess Medical Center, with a joint appointment to Harvard Medical School. Dr. Gray received his Ph.D. in molecular and cellular pathology from the University of North Carolina at Chapel Hill. He is currently working in the field of embryonic stem cell biology, a field exploring the generation of cells, tissue, and organs from stem cells isolated from early embryos or skin cells induced to a stem cell-like phenotype. His specific research interests include generating blood vessels in engineered tissues and delivering genetically engineered endothelial cells to sites of disease. Previously, Dr. Gray was a captain in the Army Signal Corps, where his duties included serving as a unit nuclear, biological, and chemical officer. More recently, he received training as a first responder for a nuclear power facility while serving as a volunteer firefighter. Dr. Gray has received numerous honors and awards, which include NIH Postdoctoral Trainee, NIH Graduate Trainee, Society for Basic Urologic Research Young Investigator Travel Award, American Association for Cancer Research Scholar in Training Award, Graduate Students Mentoring Undergraduates in Research Award (University of North Carolina), Outstanding Student Award (Radford University), and membership to the Alpha Lambda Delta National Honor Society (Radford University). He is also a member of professional organizations that include the Society for Basic Urologic Research and the American Association for Cancer Research.

Jennie S. Hwang (NAE) is the CEO of H-Technologies Group and has had a wide-ranging career, encompassing international collaboration, corporate and entrepreneurial businesses, research management, technology transfer, and global leadership positions, as well as corporate and university governance. Her work is highlighted by numerous national and international awards and honors, as well as distinguished alumni awards. Dr. Hwang was inducted into the Women in Technology International Hall of Fame and named an *Industry Week* R&D Star to Watch. In her 30-year career, she has built new businesses in corporate America, having held senior executive positions with Lockheed Martin Corporation, SCM Corporation, Sherwin Williams Company, and co-founded entrepreneurial businesses. She is internationally recognized as a pioneer and long-standing leader in the fast-moving infrastructure development of electronics miniaturization and environment-friendly manufacturing. She is also an invited distinguished adjunct professor at the School of Engineering at Case Western Reserve University and has served on the university's board of trustees since 1996. Dr. Hwang is the holder of several patents and author of more than 300 publications; she is the sole author of several internationally used textbooks published by McGraw-Hill and other European and Japanese publishers. She is a columnist for the globally circulated trade magazines *Global Solar Technology* and *SMT*, in which she addresses technology issues and global market thrusts, respectively. Additionally, she is a prolific author and speaker on education, workforce, and social and business issues. Over the years, she has taught more than 25,000 researchers and engineers in professional development courses, focusing on disseminating new technologies and providing professional advancement education to the workforce. Additionally, Dr. Hwang has served as a board director for Fortune 500 NYSE and NASDAQ-traded private companies and various university and civic boards. She has also served on the International Advisory Board of the Singapore

Advanced Technology and Manufacturing Institute, among other international organizations. Her formal education includes a Ph.D. in materials science and engineering; two M.S. degrees—one in chemistry and one in liquid crystal science—and a B.S. in chemistry. She attended the Harvard Business School Executive Program.

Anthony K. Hyder is the associate vice president for graduate studies and research and a professor of physics at the University of Notre Dame. Dr. Hyder's research is in the interaction of spacecraft with the space environment. His recent work has focused on the design of spacecraft systems, especially the electrical power and thermal management subsystems, and on the operation of high-sensitivity infrared sensors aboard spacecraft. He has also worked in the physics of high-brightness particle accelerators. He has been appointed to a number of national and international panels and advisory boards, including the NATO sensors panel, the Defense Intelligence Agency scientific advisory board, the advisory board for the Missile Defense Agency, and the Army Science Board. Dr. Hyder is a graduate of Notre Dame, with a B.S. in physics. He holds an M.S. in space physics and a Ph.D. in nuclear physics from the Air Force Institute of Technology (AFIT). He received the AFIT distinguished alumnus title in 2005.

Fred Lybrand is the vice president, North America, for Elmarco, Inc., an equipment provider for the industrial-scale production of nanofibers, where he is responsible for new markets and sales and production strategy. He has transitioned between the finance and technology sectors several times. He raised and invested $2 billion into private equity and venture capital funds on behalf of state pension plans with Parish Capital, managed sales and business development with a private-equity-backed semiconductor manufacturer, and financed a number of midmarket and seed-stage transactions as part of Wachovia Securities. Mr. Lybrand holds an undergraduate degree in biology from the University of Virginia, an M.B.A. from the University of North Carolina, and the CFA and LIFA charters.

Paul Saffo is a forecaster with more than two decades of experience exploring long-term technological change and its impact on business and society. He advises private and governmental clients worldwide and teaches at Stanford University where he is a consulting associate professor in the Engineering School and a visiting scholar in the Media-X Program. He is a fellow of the Royal Swedish Academy of Engineering Sciences and a forum fellow to the World Economic Forum. Mr. Saffo was the founding chair of the Samsung Science Board, and he serves on various other boards, including that of the Long Now Foundation, and on the Singapore National Research Foundation Science Advisory Board. Mr. Saffo writes a column on technology issues for ABCNews.com, and his essays have appeared in a wide range of publications, from *Harvard Business Review*, *Foreign Policy*, *Fortune*, *Wired*, and the *Los Angeles Times*, to *Newsweek*, the *New York Times*, and the *Washington Post*. Mr. Saffo holds degrees from Harvard College, Cambridge University, and Stanford University.

Peter Schwartz is co-founder and chair of Global Business Network, a partner of the Monitor Group, which is a family of professional services firms devoted to enhancing client competitiveness. An internationally renowned futurist and business strategist, Mr. Schwartz specializes in scenario planning and works with corporations, governments, and institutions to create alternative perspectives of the future and to develop robust strategies for a changing and uncertain world. His current research and scenario work encompasses energy resources and the environment, technology, telecommunications, media and entertainment, aerospace, and national security. Mr. Schwartz is also a member of the Council on Foreign Relations and a member of the board of trustees of the Santa Fe Institute, the Long Now Foundation, the World Affairs Council, and Human Rights Watch. He is the author of *Inevitable Surprises,* a provocative look at the dynamic forces at play in the world today and their implications for business and society. His first book, *The Art of the Long View,* is considered a seminal publication on scenario planning and has been translated into many languages. He is also a co-author of *The Long Boom, When Good Companies Do Bad Things,* and *China's Futures*. He publishes and lectures widely and served as a script consultant on the films *The Minority Report*, *Deep Impact, Sneakers,* and *War Games*. Mr. Schwartz received a B.S. in aeronautical engineering and astronautics from Rensselaer Polytechnic Institute.

Nathan Siegel is a senior member of the technical staff at the Sandia National Laboratories. He received a B.S. in mechanical engineering in 1998 from the California State and Polytechnic Institute at San Luis Obispo. He attended San Diego State University from 1998 until 2000, graduating with an M.S. in mechanical engineering. During that time he was employed at General Atomics in La Jolla and worked in the field of inertial confinement fusion energy, the subject of his master's thesis. He attended Virginia Polytechic Institute and State Unviersity from 2000 until 2004, when he graduated with a Ph.D. in mechanical engineering. Dr. Siegel's research at Virginia Tech focused on the development and validation of advanced computational models of proton exchange membrane (PEM) fuel cells. He has been employed at the Sandia National Laboratories since graduating from Virginia Tech. His research activities focus on solar interfaces for high-temperature hydrogen-producing thermochemical (TC) cycles and on the experimental validation of novel TC cycles. He has also recently been involved in PEM fuel cell research using neutron radiography to study two-phase flow within an operating fuel cell.

Alfonso Velosa III graduated from Columbia University with a B.S. in materials science engineering, from Rensselaer Polytechnic Institute with an M.S. in materials science engineering, and from Thunderbird, the Garvin School of International Management, with an M.I.M. in international management. Mr. Velosa is currently the research director for semiconductors at Gartner, Inc. In this position, he focuses on semiconductor supply chain research, with a particular focus on global manufacturing and the semiconductor consumption trends of electronic equipment manufacturers. Mr. Velosa previously worked or consulted for Intel, NASA Langley and NASA Headquarters, Mars & Company, and IBM Research.

Norman D. Winarsky is the vice president of ventures, licensing, and strategic programs at SRI International. He leads all SRI venture and license development, the SRI Commercialization Board, and nVention, SRI's partnership with the venture capital community that develops early-stage investment opportunities. Dr. Winarsky works with SRI's business units to identify and develop the company's highest-value commercial market opportunities from initial concept through commercialization as a license or venture. He has helped found more than 20 ventures, published more than 50 papers, holds two patents and has one pending, and has given hundreds of invited talks, lectures, and presentations throughout the world. He is a founder of the National Information Display Laboratory (NIDL)—a center of excellence for the government in information processing and display technologies. The NIDL is known for establishing a new model for government-industry technology development and commercialization. The program grew to become the National Technology Alliance, run by the National Geospatial-Intelligence Agency and hosted at Sarnoff and SRI International. Dr. Winarsky has served on numerous boards and is currently chairing the SRI Commercialization Board and the SRI nVenture Board, and is serving as a board member of Siri, a spinoff of SRI. In addition, he volunteers as chair of the University of Chicago Visiting Committee for the Physical Sciences Division. He joined SRI in 2001 after more than 20 years with Sarnoff Laboratory, formerly the central research laboratory for the RCA Corporation. Dr. Winarsky and his team received an Emmy Award in 2000 from the National Academy of Television Arts and Sciences for outstanding achievement in the technological advancement of high-definition television (HDTV). While at RCA, Dr. Winarsky was awarded RCA's highest honor, the Sarnoff Award for "development of the physical understanding and computer software for simulating electron trajectories in picture tube systems." He holds a Ph.D. in mathematics from the University of Chicago.

Appendix B

Meetings and Speakers

The agendas and speakers at meetings 1, 2, and 3 held by the Committee on Forecasting Future Disruptive Technologies prior to and during the writing of its first report appear in Appendix B of that original report—*Persistent Forecasting of Disruptive Technologies* (published by the National Academies Press, Washington, D.C., in 2010). The committee's first three meetings were held on October 15-16, 2007; February 26-27, 2008; and May 28-29, 2008, respectively.

This appendix presents the agendas and speakers at meetings 4 through 10 held by the committee in preparation for the writing of this second report. For a separate list of the attendees at and information on the transcripts of the one-day Forecasting Future Disruptive Technologies Workshop held by the committee on November 5, 2009, see Appendixes C through F in this volume.

MEETING 4

October 7, 2008
Alsop Louie Partners
San Francisco, California

Writing Meeting

MEETING 5

November 6-7, 2008
Keck Center of the National Academies
Washington, D.C.

X2: Threats, Opportunities, and Advances in Science and Technology
Cesar Castro, Institute for the Future

Future of Science—Year 1
Cesar Castro, Institute for the Future

X2 Project: Year 1 Report
Cesar Castro, Institute for the Future

Palantir Demonstration
Trae Stephens, Palantir Technologies

Blue Horizons (BH) II 2008 Final Report
Theodore Hailes, Center for Strategy and Technology, Air War College

The Impact of Future Technology
Ruoyi Zhou, Almaden Research, IBM

Cultural Impacts of the Internet
Timothy Mack, World Future Society

MEETING 6

January 7-8, 2009
Beckman Center of the National Academies
Irvine, California

X2: Threats, Opportunities, and Advances in Science and Technology
Cesar Castro, Institute for the Future

Implications of Financing to Disruptive Energy Technologies
Preston Roper, Tioga Energy

Prediction, Expectation, . . . and Surprise
Eric Horvitz, Adaptive Systems and Interaction Group, Microsoft Research

The New Global Challengers, and Globality
David Michael, Boston Consulting Group

Road to Cost Effective PV
Ajeet Rohatgi, Suniva, Inc.

An Emerging Disruptive Technology: Fuel Cells
Scott Samuelsen, Henry Samueli School of Engineering, University of California, Irvine

MEETING 7

March 3-4, 2009
National Academy of Sciences Building
Washington, D.C.

Forecasting Future Disruptive Technologies, NAS Committee Update
Cesar Castro, Institute for the Future

Science and Technology Future
John Retelle, Potomac Institute for Policy Studies

Evaluating Disruptive Technologies in the Healthcare Industry (Teleconference)
Molly Coye, Health Technology Center

Globalization and China's Emerging Technological Trajectory: Issues and Implications
Denis Simon, School of International Affairs, Pennsylvania State University

Disruptive Technologies: Trends and Predictions
James Lewis, Technology and Public Policy Program, Center for Strategic and International Studies

Practical Forecasting Tips
Lawrence Vanston, Technology Futures, Inc.

Technology Forecasting in the Telecommunications Industry
Lawrence Vanston, Technology Futures, Inc.

SRI's Process for "Forecasting" Disruptive Innovation
Norman Winarsky, SRI International

MEETING 8

June 30-July 1, 2009
Keck Center of the National Academies
Washington, D.C.

Renewable Energy: Maintech, not Cleantech
Vinod Khosla, Khosla Ventures

Innovation Global Technologies
Mark Minevich, Billion Minds Foundation, Going Global Ventures

Defense Planning Strategies
Christopher A. Preble, Cato Institute

Forecasting Future Disruptive Technologies, NAS Committee Update
Cesar Castro, Institute for the Future

A Science Fiction Writer's Perspective of the Future (Telecon)
Bruce Sterling, Writer

KAUST 21st Century Research University on the Shores of the Red Sea
Ken Minneman, King Abdullah University of Science and Technology

Thoughts on Disruptive Technologies
Maren Leed, International Security Program, Center for Strategic and International Studies

MEETING 9

August 3-4, 2009
Keck Center of the National Academies
Washington, D.C.

Shell Energy Scenarios to 2050, An Era of Revolutionary Change, Scenario Thinking
Jeremy Bentham, Royal Dutch Shell

Why Have Some States Opted for Nuclear Weapons While Others Have Renounced Them?
Etel Solingen, University of California, Irvine

A Multidimensional Overview of Complex Undertakings
John Hofmeister, Citizens for Affordable Energy

U.S. National Security in the 21st Century
David J. Williams, Military Science Fiction, Writer

DTWS Briefing
Ever Morales, Defense Intelligence Agency

Forecasting the Technology Revolution
William Halal, George Washington University, TechCast LLC

Prediction Is Difficult, Especially About the Future
Bernard Meyerson, IBM Systems and Technology Group

Science and Technology Development, From the Combatant Command Perspective
Martin Drake, U.S. Central Command

Remarks to the NRC Committee on Forecasting Future Disruptive Technologies
Benjamin Riley, Rapid Reaction Technology Office

MEETING 10

Forecasting Future Disruptive Technologies Workshop
November 5-6, 2009
Federal Reserve Bank Building
San Francisco, California

See Appendix C in this volume for information on the workshop attendees and Appendixes D and E for the unedited transcripts of the workshop, which are reproduced on the CD attached to the inside back cover of this report and in the PDF available at http://www.nap.edu/catalog.php?record_id+12834.

Appendix C

Workshop Attendees

Following is a list of the participants in the November 5, 2009, Forecasting Future Disruptive Technologies Workshop held in San Francisco, California, by the National Research Council's (NRC's) Committee on Forecasting Future Disruptive Technologies.

GUESTS

Stewart Brand, The Long Now Foundation
Mark Culpepper, SunEdison
Richard Genik II, Emergent Technology Research Division, Wayne State University
Philip Koh, Gartner Advisory (Singapore Pte Ltd.)
Darrell Long, Jack Baskin School of Engineering, University of California, Soquel
William Mark, SRI International
Mark McCormick, McLiera Partners, LLC
Jim O'Connor, Monvia
Benjamin Reed, Yahoo! Research
Ray Strong, IBM
Paul Twohey, Trumpet Technologies
Stan Vonog, Musigy
Philip Wong, The Walt Disney Company
Michael Zyda, University of Southern California GamePipe Laboratory, Department of Computer Science

COMMITTEE MEMBERS

Gilman Louie, *Chair*, Alsop Louie Partners
Harry Blount, DISCERN
Stephen Drew, Drew Solutions, Inc.
Danny Gray, Case Western Reserve University
Jennie Hwang, H-Technologies Group
Fred Lybrand, Elmarco, Inc.

Paul Saffo, Saffo.com
Peter Schwartz, Global Business Network
Alfonso Velosa III, Gartner, Inc.
Norman Winarsky, SRI International

NRC STAFF

Daniel Talmage, Study Director
Sarah Lovell, Christine Mirzayan Science and Technology Policy Fellow
Kamara Brown, Research Associate
Shannon Thomas, Program Associate

FACILITATORS AND VISUAL PRACTITIONER

Derek Bothereau, Monitor 360
Jessie Goldhammer, Monitor 360
Carolyn Mansfield, Monitor 360
Phil Nolan, Monitor 360
Teresa Smith, Monitor 360
Lynn Curruthers, Global Business Network

Appendix D

Transcript of the Workshop

The full unedited transcript (combined sessions) of the November 5, 2009, Forecasting Future Disruptive Technologies Workshop is reproduced on the CD attached to the inside back cover of this report and in the PDF available at http://www.nap.edu/catalog.php?record_id=12834.

WORKSHOP AGENDA

8:30 a.m.	Welcome, Introduction, and Goals for the Day
9:15 a.m.	Review Draft Model from Report 1
9:30 a.m.	Group Discussion: Key Product Design Challenges to Consider
10:30 a.m.	*Break*
10:45 a.m.	Group Discussion: Defining Product Tradeoffs for the End Customer
12:00 noon	*Continued Discussion with Lunch*
1:00 p.m.	Team Activity: Designing a Scanning System
3:00 p.m.	*Break*
3:15 p.m.	Team Activity: Identifying the Human and Technical Requirements
4:30 p.m.	Open Questions from the Committee and Next Steps
5:15 p.m.	Closing Remarks

Appendix E

Transcript of the Workshop's Breakout Sessions

The full unedited transcript of the subgroup breakout sessions of the November 5, 2009, Forecasting Future Disruptive Technologies Workshop is reproduced on the CD attached to the inside back cover of this report and in the PDF available at http://www.nap.edu/catalog.php?record_id=12834.

Appendix F

Visualizations of Workshop Discussions

During the Forecasting Future Disruptive Technologies Workshop, Lynn Curruthers, a visual practitioner, assimilated ongoing discussions at two workshop sessions and produced the three graphics presented in Figures F-1 through F-3 and, for ease of viewing, included on the CD provided with this report and in the PDF available at http://www.nap.edu/catalog.php?record_id=12834.

Figures F-1 and F-2 were drawn during the first of the morning sessions, and Figure F-3 was drawn during the summary session. The workshop attendees kept track of the graphics as they were evolving, and offered suggestions and changes to make sure that everything from the session discussions was included.

Figure F-2 is meant to be read as a continuation of Figure F-1. Figure F-3 was produced at the end of the day from the workshop attendees' overall final observations.

FIGURE F-1 The first three key areas: Defining the Unknown, Avoiding Data Overload, and Gathering Outside Perspectives.

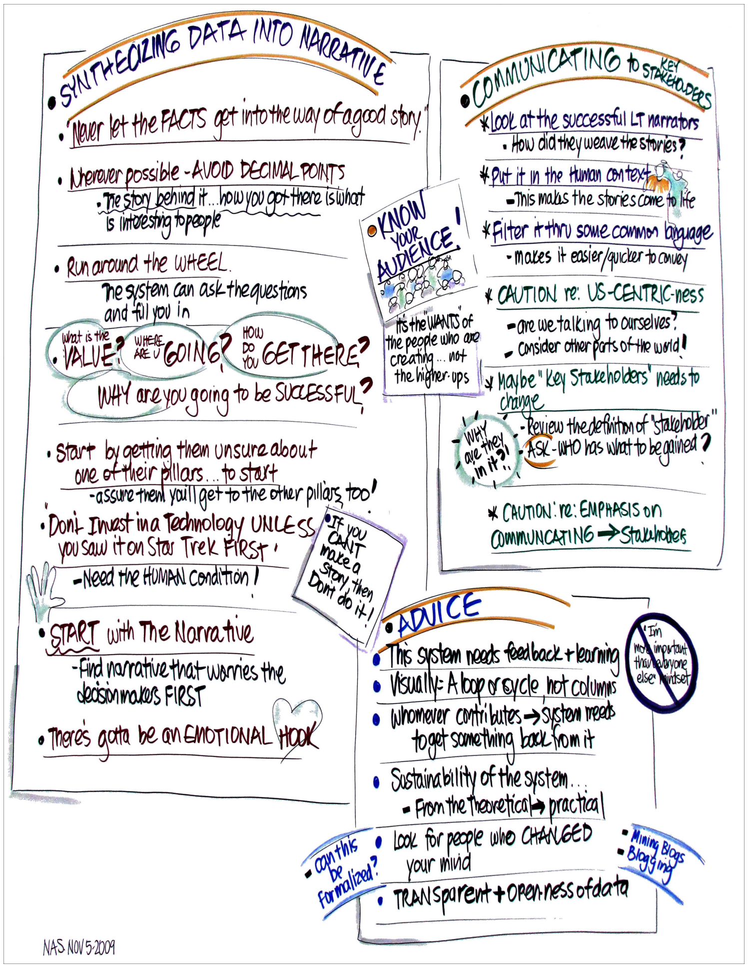

FIGURE F-2 The second three key areas: Synthesizing Data into Narrative, Communicating to Key Stakeholders, and Advice.

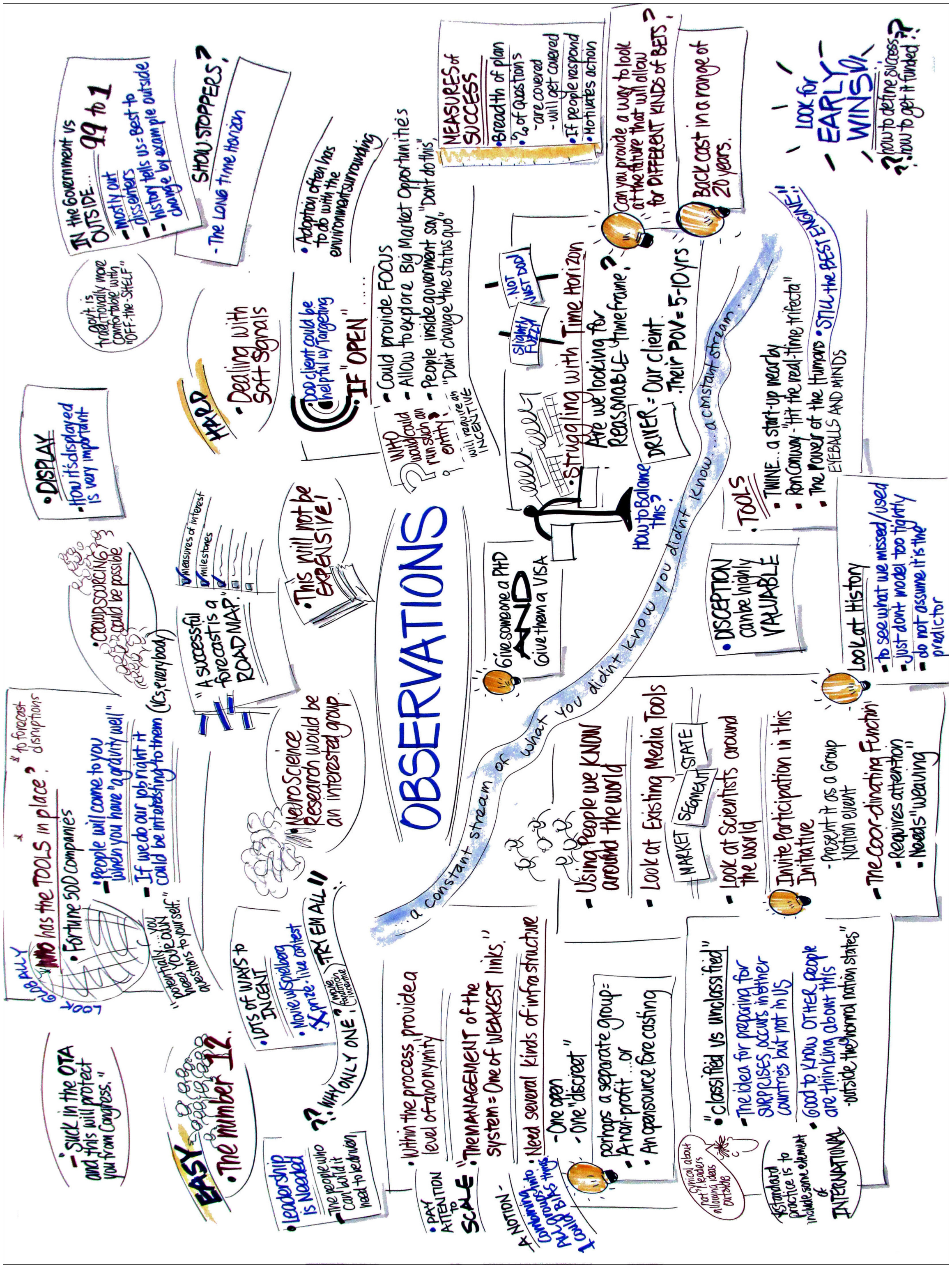

FIGURE F-3 Overall observations of workshop attendees.

Appendix D

Transcript of the Workshop

8:30 A.M. – 10:30 A.M.

Due to a recording issue at the start of the morning the introductions of some attendees are not shown here.

SCHWARTZ: …Forbes, a student of Paul Saffo, a member of the committee, and I spend most of my time in GBN, helping organizations think about the future in a great variety of ways. And what excites me about this day, frankly, is we've been at this now for a couple of years pulling all the pieces together and making sense of it.

MANSFIELD: I'm Carolyn Mansfield. I'm a new addition to the Monitor 360 team so I'm excited to be here because Derek's had me doing a crash course on everything you guys have put together so far and I'm just excited to see the ideas that crystallize out of the day.

McCORMICK: I'm Mike McCormick. I'm with McLiera Partners and we basically help companies use disruptive technologies in the marketplace to gain market share. I'm excited today about basically seeing different perspectives. I think one is a good friend of mine who's got a great definition of wisdom, which is being able to see the same situation from multiple perspectives simultaneously at a time and I think this is kind of an interesting opportunity to be involved in.

DREW: I'm Steve Drew. I'm a member of the committee and a consultant of the pharmaceutical and biotech industries. What excites me is the role that biology will play in every aspect of our lives, all of the technologies, all of the directions that we go. And I'm seeing ways in which that's coming together.

LONG: I'm Darrell Long. I'm a professor of computer science at University of California. That's my day job. I also spend a lot of time working with the government Department of Defense and intelligence communities in particular. And I used to be a member of the TIGER committee involved here. What excites me about this is looking at technologies coming not just from my discipline but from other disciplines, physics, engineering, biology and seeing how they can come together and try to understand what might happen when these things come together.

VELOSA: Hi. I'm Al Velosa from Gartner, another market analyst trying to, and I think failing, as somebody else said, to forecast technologies markets and all sorts of good things like that. But it's a really fun activity to do. And what I'm really excited about actually is to look at somebody else's, actually just looking at markets with this set of talent because I always learn something from talking to folks like you.

TWOHEY: Hi. My name's Paul Twohey. I'm a recovering academic so I'm now an entrepreneur and so I used to work at Palantir and now I've got a startup that we're hoping is going to disrupt some markets ourselves. And I'm kind of excited about getting a glimpse into the future with some really smart people and making sure it turns out right.

LYBRAND: Hi. I'm Fred Lybrand. I'm on the committee. I run the U.S. operations for an advanced textiles company that's headquartered out of Europe and have started a company around food safety and nutrition using IT perspectives. And similar to Peter, I'm enthused about the opportunity for synthesis in a lot of the ideas that we've been talking about for almost two years now.

ZYDA: Hi. I'm Mike Zyda. I'm the founder of the Games Program at USC, the Director of the USC GamePipe Laboratory. I'm also advisor to five startups, probably the most, two most exciting are Emsense, which is a brain sensing, human emotion modeling company, which now has offices in San Francisco, New York, Chicago, London. We started this in 2004. It's growing real quick. And also Happynin Games, which we founded in September. My brother is involved in that. And I hired 15 of my own students from my own program, which is pretty fun. How does my professional work link to this topic? I'm just kind of a disruptive kind of guy and maybe you need – [General laughter] – someone like that, and I just -- So what I typically do is I go and do what makes perfect sense to me and I just go make it happen. And this is, you know, I tried this in a military school. I was at the Naval Post-Graduate School for 21 years and founded the largest cross-disciplinary degree program there at the MOVES Institute. Built a hit game inside of the school, *America's Army*, through its almost four million registered players. No one told me you're not supposed to build a hit game, build an operating hit game inside of a university but what the heck, I just do what I feel compelled to do. I've also helped found a nonprofit in the last year called The Fight Against Obesity Foundation and it is sponsored by Steve Harvey, the comedian, if you know that. We're just about to buy a building in Inglewood, California, to support a group that encourages proper diet choices and fitness. Anyway, what excites me about this meeting? A lot of interesting people, San Francisco's fun, Gilman Louie, of course. You know, I always like to come to his meetings and listen to, know what he has to say and so I think it's lots of fun to talk about the future. I think it's really hard to predict the future. I think it's, the future just happens and I think sometimes you have to just jump from what you're doing and go to the next thing. So I got to do that. I quit my tenured full professor job on my 50th birthday and took a new position at USC and founded a game program. So that's the kind of guy I am and that's why I'm here.

GOLDHAMMER: Thanks, Michael. Philip?

WONG: I'm Philip Wong. I'm with Walt Disney Parks and Resorts. I'm the director of Business Planning and Development. I have a small team that basically looks at any sort of strategic issues and population actually has, so these can range from issues around technology, they can also range from capital restructuring. So basically – and also forecasting and planning. So we cover a whole range of issues all across the company. The reason I'm interested – I'm going to do this the other way around. Before I actually joined Disney I was in technology for about close to a decade, started off my career at NASA, worked at actually Hughes Communications, Inc for a while, designed a satellite

Transcripts were not edited.

system for the ICO Global Communications, which was a mobile satellite communication system. Didn't fare so well. Realized the business implications in that.

SCHWARTZ: Nor did Iridium.

WONG: Nor did Iridium but it was a great technology. And then joined a couple startups and we actually took one startup that I worked on, which is an IP company, CallWave public, a number of years ago, and so really sort of enjoyed working in that environment, which was very disruptive in terms of the technology that we were looking at. And what I thought was fascinating about that was that the disruption in the technology field came from sort of the down market and not necessarily the up market, which is the performance, sort of the performance aspects of the technology. And so I've always been, even what I do now I think we're all constantly looking and being careful about what could disrupt our company's business. And so I'm a firm believer in a Christensen sort of framework for disruptive innovation and so just very excited to be participating in sort of a forum where we can actually discuss disruptive technology.

GOLDHAMMER: Great, thank you. Rich?

GENIK: I'm Rich Genik from Wayne State University School of Medicine. I'm the Director of Emergent Technology Research there. We mainly are dealing with neuroscience and neuroimaging, looking at, trying to do two things at once, which I was reading and talking so I didn't do too well there, like talking on a cell phone and driving a car. Being from Detroit, we got a lot of support from the auto industry, used to have a lot of support from the auto industry. [General laughter] What I'm excited to be about, be here today is looking at approaches to predicting future disruptive technologies that are non-Delphic models and also the difference between forecasting and predicting and to be with a group and participate in looking at those specific items.

GOLDHAMMER: Great.

WINARSKY: I'm Norman Winarsky. I'm on the panel as well. At SRI I am responsible for launching ventures in licenses from SRI, disruptive technology opportunities. I'm excited because I'm going to learn from bright people.

GOLDHAMMER: Good. Jim?

O'CONNOR: Hi. My name is Jim O'Connor. I think the most relevant experience from my past is the fact that I was at Yahoo! Finance for seven years as the Director of Product Management, spending most of my time figuring out how to manage large sets of data, translate them and display them in a very easy to consume fashion, not necessarily to finance professionals but to the average retail investor, as well as working on communities, trying to figure out what kind of intent and how to mine that data so that it would be more helpful to the retail investor. My current position, I'm a partner at a small company called Mondia down in Mountain View, where we're a startup incubator/accelerator, helping small startups move from the idea stage to reality as quickly as possible. I think I'm most excited here – when I went through the bios I realized I'm the least educated person in the room probably, which is really exciting for me 'cause I enjoy being, you know, not the dumb guy but the least educated person. [General laughter] Because I know I'm going to walk out of here tomorrow, you know, or today, smarter than I was when I walked in this morning. And going through all the papers last night, I think the most interesting thing for me really is taking this really massive boil-the-ocean project and try and figure out how does it go from where it is, kind of a concept stage, into reality and in particular, kind of what the interfaces look like because there's, you know, a wide breadth of ideas in what we all went through last night. And then also I think in one of the papers there was a comment that said that it's very difficult to predict the future but the more you know about the probabilities and the possibilities and discuss them, the more ready you are to react to them if they actually become a possibility. I think that's something that's very exciting.

GOLDHAMMER: Great, thank you.

DOLAN: I'm Phil Dolan with Monitor 360. Apologies for showing up a few minutes late. I do most of my work with Herrick, Feinstein LLP the national securities establishment. What I'm most excited about is not disruptive technology per se but disruptions that cut across domains and how technologies that are small improvements in one domain in fact can be dramatically disruptive in another and vice versa.

GOLDHAMMER: Great. Did I miss anyone?

UNKNOWN: Gilman.

GOLDHAMMER: No. We got Gilman. But now what I'd like to do is pass the baton to Gilman, who is going to set some context for us about sort of what the committee has been doing for the last, I think it's a year and a half now.

UNKNOWN: Two years.

GOLDHAMMER: Almost two years? Almost two years, setting some context for what the committee's been up to, what we're going to be doing today and what success would look like at the end of the day.

LOUIE: Thank you. So as I said earlier, my part-time job is being a venture capitalist so basically what I do is I kind of sit on my butt in my conference room and listen to startups pitch us, usually slide ware. You know, they come on in and they say they're going to change the world, have a great idea and they throw up a bunch of slides. So one of the things I learned from that exercise is, you know, it's a very effective system of going through lots of, lots of ideas of which the entrepreneur has done very little work. That's the key. The entrepreneur has done very little work. And so one of the goals of this exercise that we're going to be going through today is think of ourselves as a startup and can we come up with our own pitch deck to be able to say before we build anything, before the government goes off and invests whatever large sums of money they usually invest in big systems, you know, think about what are the possibilities and what could this thing look like before we actually build it. So that's kind of one of the objectives. I mean, another objective is, you know, as in any 1.0 startup, you know, a guy comes on in or a woman comes on in and says, "I've got the billion dollar idea. Please give me $100 million." Sometimes they come in, "Please give me $2 billion to give me the $1 billion idea." Whatever. The point is, I usually come back and say, "Well, you know, I've only got this little bit of money. I'll give you a little bit of money if you can prove out the concept." And so one of the exercises on any kind of 1.0 activity, and we consider this kind of a 1.0 activity, is what is the least amount of money, the least amount of energy we could expend to even prove out that the idea has any traction. So this is not about an exercise

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about building, you know, the system to end all systems in the next 12 months. It's not the Manhattan Project. But, you know, can we come up with some sort of a framework to think about what the problems are. And so this is airplane ware, which is kind of traditional for any startup. Airplane ware is when you've got a meeting with a venture capitalist and you're flying across the country, as I was last night, you know, I need to put a pitch deck together. I start working on my slides. So what's good about slide ware, airplane ware, is the latest thinking, good and bad, all consolidated into a single pitch deck, okay? So there's very little thought but a lot of feelings that have gone into the slide deck, which is kind of what we started off with when we started off this committee, which is we had a lot of hunches, we had a lot of ideas. We wrote a first report kind of looking at the history of forecasting, put some of the concepts together as hey, somebody should think about these kinds of concepts. Most of it is what I call feeling based rather than fact based, which is okay. Any new endeavor, particularly disruptive technologies, starts off with a feeling, hardly ever starts off with real fact and data because there fundamentally are not facts or data to start with. So one of the things we started thinking about maybe was, you know, before we jumped into technology, just think why we have disruptive events. And on the [..?..] of these kind of disruptive activities -- it could be a piece of technology, it could be, you know, not seeing 911, Pearl Harbor, whatever it is that is disruptive -- why didn't we catch it? And then of course whenever you look backwards it's immediately obvious that you should have seen it. So we came up with kind of our laundry list of what causes these kinds of surprises. So the first thing is not knowing enough to even ask a question, right? When you kind of get smacked up on the side of the head it's usually because you weren't looking at where the punch was coming from. So not knowing enough to ask a question or you could have asked a really good question but you didn't ask that at the right time. You know, the environment wasn't right for somebody to get good signals or responses or answers out of it. This is my favorite. This is the problem of experts. They assume what has happened in the past is going to happen again, right? I've done this 20 years ago. It was a total failure. This young kid is dumber than I am. She will totally fail as well. A lot about mirroring, this idea that somebody else is going to tackle the problem, look at the situation the same way I'm going to do it. They'll never go down that path. That makes no logical sense. That is totally crazy. A rational person would never do this. One of the things interesting about disruptive tech is rational people don't make disruptive technologists. Highly irrational, highly focused, somewhat crazy, definitely not normal people. If you were normal you'd probably have a day job and you'd go home, put the kids to bed and enjoy life. If you're abnormal, you create companies like Oracle, Apple, Google. Information fragmentation. Lots of information around. There's lots of noise and it's all over the place and you can't figure out which is the good information from the bad information, information overload, way too much stuff coming in. I can't figure out what's going on. Biased institutions, bias, your own personal bias, bias of the community, dismissed, potential outcomes. And finally, the most important one, is my favorite, came out of the 911 Commission on why we were able, not able to predict it: a lack of vision. There's also another one I didn't put on here, is dismissing visionaries as crazy, uneducated or not experienced enough to understand what the real world is all about. So we had to wrestle with what is a disruptive technology, you know? Is that something that just suddenly appears on the scene and changes the world overnight or is it something that slow brews for 20 years and is something that changes that has sudden impact? So we came up with these kind of four concepts around disruptive tech and everybody has their own version but this is our committee's definition. It's innovative technology which triggers sudden and unexpected effects. It doesn't mean a *new* technology which triggers sudden and unexpected effects, just saying innovative technology. It could have just appeared on the scene or it could

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have been around for a long time and somebody figured out how to use it in a different way. It refers to that type of technology that incurs a sudden change of established technologies in markets. These have real impact, right? It’s really hard to have something that is disruptive and has no impact so impact is really, really key. It can include technologies that really change the balance of global power. There’s this kind of hats off to our DOD government friends but in many cases technologies have broad impact. They just don’t impact a particular region. They may start off impacting a particular region or a particular market segment but it quickly begins to spread and has global impact pretty quickly, especially these days. Then of course they’re hard to predict, they’re highly infrequent and, you know, there’s lots of factors that make it hard to see it coming. Huge difference between evolving tech and disruptive tech. So Al Shaffer, who was director of plans and programs inside the DOD in 2005, said from the DOD’s perspective there are three reasons why we’ve really got to understand disruptive tech. One is just to be competitive, right? It doesn't matter whether you’re in a corporate environment or whether you’re in a nation state environment from a military point of view. If you don’t stay current on technologies and begin to try to think about how technologies can impact you, you’re no longer going to be competitive in the marketplace. This is kind of obvious to all of us in this room. The U.S. is not the sole keeper, creator and distributor of high quality technologies that have disruptive impact. Pretty important for kind of policy issues, which was in the old days that we’re going to solve the problem by not letting any of the good stuff out. Doesn't make a whole lot of sense because – but now we have a problem, is does the good stuff even get in. And then quite frankly, we need to stay engaged with the rest of the world. Now I’m not just talking about the rest of the world from the defense, military point of view. I think DOD does a pretty good job – you know, nobody’s perfect – but does a pretty good job of understanding what I call, you know, what the big systems are that they may run into done by big nation states that require billions of dollars of investments. We have whole organizations who think about what those platforms might look like. We have whole organizations that go out to listen what other people are doing, and some organizations that go out and steal what other people are doing. Okay, that’s not what you’re talking about. What we’re talking about is kind of disruptive technologies in plain view. What are the kind of technologies out there that we all take for granted, they don’t have obvious military applications and we wake up, we go into a country and this surprises us in a very fundamental, profound disruptive way. IEDs are kind of a good example of that, right? But there are, you know, many more kinds of technologies. The Internet, mobile phones, well next generation wireless toys, all could have an impact to Department of Defense. And so what they asked us to do is don’t think like us because we already know how to think like us. Think like the market. Can you encourage a group of thought leaders from around the world to participate in a system that has value well beyond the Department of Defense of the United States that thinks about disruptive technology and it’s okay if it’s shareable by everybody. You know, we can figure out what we want to do with it and use it our way. Chinese can figure out what they want to do with it and use it their way, the Russians, Israelis, you know, GM, Nokia. If you have a valuable system it should be valuable to everybody. So is there a way to kind of come up with, for lack of a better term, kind of the Wikipedia of disruptive technologies. So what makes a good forecast? Many people here are forecasters. A few of you are actually people who think they, they do predictions. But a good forecast is not necessarily an accurate forecast, right, because it’s really hard to know when you make a forecast whether or not you’re going to be accurate, right? Really hard to do. You can go well, you know, this person has a good batting average but at that moment at the plate that person could strike out, right? So what makes a good forecast? So first of all, in some ways it’s more important to understand the impact of potential disruptive technologies than actually understanding the technologies themselves. What is the world or what could the world look like, right? Hey, we might have gotten it wrong. It might not have been an electric car or a hybrid car. It might be some other kind of car, another kind of vehicle. What's important to realize is, in this particular view of the future, that we may not be using cars that consume petroleum. In some ways that is more important than figuring out this specific technology this week, which we think is going to cause that to happen. You should increase the lead time for stakeholders to plan and address potential disruptions. In the range of potential impacts that are out there a good forecast gives a person a view to help them prepare and increase the time in which they begin to think about how they plan and how are they going to react to potential futures. This is also very important. A good forecast should allow somebody to slightly change the odds from 100% random to slightly better than random. So should think of it as card-counting in Black Jack. Doesn't guarantee at any moment in time that you're going to have a winning hand but over the long term of playing the game out, you beat the house odds by just changing it just a little bit. A good forecast is like counting cards. Doesn't guarantee a win, it just begins to subtly shift the odds in your favor. And most importantly and a lot of forecasters forget this, is at the end of all the forecasts is what do we look for to see whether or not a forecast is coming true or not coming true? What are the signals, what are the signposts, what are the thresholds, what are the tipping points that we should be out there listening and monitoring for to say oh, my God, it's happening? So think of it as a chess game. You're sitting there and you're playing a Grand Master and the Grand Master looks at the chessboard, in about ten seconds says, "Oh, I see a pattern here. It just kind of looks like that game. I know my next eight moves." To a novice, you look at the board and go, "I don't know what the heck to do next." So an early warning system is kind of having what I call that opening book in a chess program, right? Now how can we fill that opening book, those pattern recognitions that allows somebody to say, "Hey, this might be coming true, this may not be coming true"? So when you would see me down whining in the TIGER Committee – so the TIGER Committee is this standing committee for the National Academies of Science in which they put really, really smart people and a few not so smart people, like myself, in a room to think about these problems. And we were just sitting around whining about how poorly we have done in forecasts. The Department of Defense, the intelligence community has effort after effort after effort to produce what is fundamentally the same list of stuff. So the general process is we go out, we might use the Delphi method, we might go out and do a survey or we might have some analytical exercise and you always come out with the same list. And we kind of say why is this list always the same? There's always bio, nano, you know, computation. Recently we've added neural, you know. There might be two more layers of depth in there but it's always the same list. And if you go back twenty years and kind of look at historical forecasts, there's always the same list. But what was amazing is the list, how inaccurate and how wrong it is. In fact the greater level of experts participating in the forecast increases the likelihood that that forecast is going to be more inaccurate, which is kind of weird, right? You stand a better chance of looking into the future by asking people who read science fiction with no education than asking people who are highly educated in the particular subject matter, expert, and say, "Can you predict the future?" So we said, you know, one of the causes could be because we always go to the same group of experts. You all speak English, all cleared, which, you know, to be cleared it automatically takes even a population from here down to five people so, you know, it's highly Western oriented, highly American bias. Particularly on the technology side it is high tech bias. We like shiny objects. We like really expensive shiny objects. We like really expensive shiny objects that nobody else can see, right? That's our bias, you know? If it has like bolts hanging off and a big airplane, right, and if it has vacuum tubes on the inside, we

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immediately dismiss it as so yesterday and sometimes that could cause some of the lack of understanding of what the possibilities are. We've very tech focused and we're very list focused. We're not impact focused and we don't explore the secondary effects, which is if you had all these technologies what will you do with them beyond the obvious use of those technologies? Because the most impactful disruptive technologies typically aren't new technologies but aggregations in a system of existing technologies used in a new and profoundly different way that nobody ever anticipated before, right? So you have these four secondary effects, not just look at wow, you know, it's nano, it's really small. Well that's kind of interesting but what impact, how could that be used to create something else? This is really important for the next 15 or 20 years because there is this gut feeling that we're kind of like once again, just like the Einsteinian revolution, on that brink where you're going to have this convergence of technologies, science, quite frankly the human condition coming together to create these really unbelievable opportunities for great disruptions and we just quite don't know where it's going to come from or from any one particular field of science.

Forecasts typically are going to provide snapshots that are increasingly obsolete. The moment you forecast it it's over. There is this overwhelming tendency, particularly for people who use the Delphi approach, to go for a consensus view. That's pretty good when you try and forecast technologies but disruptive technologies you're really more interested in the tails. So you're more interested in many cases in the stuff that people dismiss than the stuff that they agreed upon. And so one hunch we have is you should do the consensus view, use that as the mask and ignore it, right, and then get to the tails. And finally, these forecasts are very, very difficult to make actionable. So we spend a lot of time talking to ourselves, talking to other folks who participate in creations of these kinds of forecasts, we talk to technologists, we talk to folks from the Department of Defense, we talk to some people from other countries. We went out to different countries and explore around. And so here's our hunches. Again these are hunches. There's no foundation in fact or proof. Our hunches. A good forecasting system should be persistent, right, should be kind of hey, gee, you know, what's the current thinking, you know, pull it up on your website, be able to kind of go through it and scan it and have it try to be as up to date as you possibly can. So it should be living rather than a moment in time. It has to be not focused on DOD needs because if you focus on DOD you start focusing on things that go boom. Things that go boom takes a certain logical way of kind of building down the path of things that go boom. War may not be about in the future of things that go boom, right? It might be -- remember, war is the final stage of making somebody else do something that they don't want to do and you've exhausted all other possibilities. That is the military's application of force. There are many other kinds of force and potential force that we may not be considering which may be the definition of war in the future that is not the definition of war today.

Third point. Don't ask the experts. Ask the people who are most likely who are going to be affected by the great disruptive changes. Ask the people who most likely are going to create those disruptive technologies and it's partly not going to be, though there may be a few in this room, that many who look like us. They're probably people today who are just kids. And what we call kids, anybody under the age of 30. The second thing of that is we said besides go young, look at what they're betting their lives on. After you finish your post-doc program, what would be the great program for you to work on next that you want to do, not what your professor wants you to do and what your department head wants you to do. What is it, as an entrepreneur, that you're willing to risk the next four years of your career and life to go pursue? Ask those kinds of questions. Go abroad and

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don't ask them in English. You know, it's kind of fun. I grew up in a household, I'm the only English speaker in my household. My 4-year-old and 6-year-old speak three languages, English, Mandarin and Cantonese and learning Japanese now, right? They give me a completely different answer in English than they give mommy in Chinese, right? So a hunch is if you ask somebody in English they may give you what they think you want to hear versus listening to what they would normally be talking about in their own language that naturally occurs. And the subtlety of language is really, really important. Assume the world is lumpy. I know everybody read "The World is Flat". I know we think this is a global world. Technologies impact people differently. Different countries, different technology clusters have different priorities. So if you're sitting there in the Middle East and you worry about what's going to be life like when oil kind of is no longer important in the world, and that may be a completely set of priorities than somebody in India trying to figure out how do I deal with billions and billions of people who are starving and get them into the modern world, versus somebody who's sitting off in Europe thinking about, you know, the next Collider project, right? The world, while maybe relatively flat, I suspect, we suspect it's very lumpy along the way and understanding the lumpiness is important. One methodology doesn't fit all. You know, we don't believe, after kind of looking at all these approaches that we can create one approach that will obsolete all other forecasting approaches and our gut hunch is that we should consolidate lots of different approaches into kind of this grant repository, a multiple repository, that …..[Mic noise] This was highly debated, particularly because we are the National Academy of Sciences. Our committee thinks there's value of engaging the crowd as well as experts. So crowd sourcing we think has a role in this as well as expert sourcing. We're not a subscriber to either camp that believes one replaces the other. We actually think both are important. How to use the crowds and how to use the experts is something that we kind of wrestle with and try to figure out. Web technologies we think will be very useful. Don't boil the ocean. We said that already. Don't launch a Manhattan Project. Any forecasting should have more than one future being prognosticated and we think backcasting may be very useful as a tool to kind of figure out how to develop a signals pattern that can actually be in the monitor and it needs to be impact focused rather than ….[Mike noise].

So forecasting disruptive technologies. Four key things that we think that any particular forecast or any particular technology or impact should include. One, it should include a vision. Forecast a reality describing the vague way. Trying to be too specific is actually a bad thing in many cases. It should include a measurement of interest or measurements of interest. You know, what's the thing that will change if you change the tipping point could be the cost of energy stored in a unit, a mass, that once that number crosses a threshold, that is the key thing that starts everything flowing. There should be some signpost. Hey, you know, these things happen. You know, there's an indication that this either will happen or might happen or can't happen, and then the actual signals themselves. Report 1. You guys, I don't know if you guys had a chance to read our lovely Report 1 but it's long and boring and will put you to sleep. But it did have these six major sections, which is, you know, basically like just looking at the past, looking at the forecasting approaches, some things that we talked about and discussed a lot of issues around bias because we think that was a really, really critical thing that basically handicaps most forecasting approaches. And then we looked at some persistent systems.

So why are we here? We want a lot of new ideas and some old ones. We want to learn from the experience of folks, we want to explore some new methodologies as well as figuring out what existing methodologies could be used in a unique way that could add

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to the answers. And we want to develop a framework for Version 1.0. So when we thought about Version 1.0 and somebody said, “So what is Version 1.0? I mean, what do you guys really want?”, first is start with the output, right? Whenever you design a video game, start with what the screen shots will look like, right, because if the screen shots aren’t that exciting and the kids don’t want to play it, then it doesn't matter all the great algorithms you have in the back side, doesn't matter how good the input was, right? Start with the output. Then think about what are the sources that you have, what are the resources that are out there that you can actually provide for useful input once you figure out what people would actually use on the output. Then define the methodology. Come up with a simple block diagram of both the human process as well as the machine process. It’s not just a machine, you know, of computer science mapping. It’s that you are going to go through a persistent forecasting system where there are humans, there are computers, there’s information sources. Can you define kind of a high level block diagram of what that would look like? Could you come up with a way of tracking signals and tipping points and then at the end of this all the reasons why this is going to fail, won’t work or some of the challenges that we’re going to run into. So somebody asked me what’s the ideal output look like. Now this is my gut. I don’t want to bias you to work on this list. But the thing that fascinated me most was, you know, in my prior role I ran In-Q-Tel for the Central Intelligence Agency, which is kind of a venturing organization to go out and get good ideas in Silicon Valley and other places in the United States. And so the CIA comes out with this book called the “World’s Fact Book.” Basically it’s this book and you go by country and it lists kind of all the key attributes of that country and some of the issues it has. So that kind of biased me in saying gee, you know, it would be great to have kind of the “World Fact Book” for forecasting. I can flip to a country, you know, I can kind of go and say well, Georgia, what are the issues in Georgia today? Now what’s your technical bets? What are your universities thinking about, what kinds of technologies are going to impact them? But most importantly, what are their big knotty problems? I suspect that if you try to figure out people’s problems, you put resources into solving problems or creating opportunities. So if you had an output that basically didn't say, you know, here’s the world and here’s the ten technologies that impact the world, I think it would be more useful to say, you know, by country or region or by technical cluster, here’s the problems and opportunities they’re going to work on. Here’s how they’re beginning to think about the problems. These are interesting sources of technologies and uses of technologies.

So there’s a bunch of questions that we’ve got to ask ourselves if we actually build this system. A), would anybody use it? A good question that we get repeatedly is since this is kind of sponsored by the Department of Defense, why would anybody else in the world participate? Why should they even trust the system given the history of U.S.-based technologists? One argument says well, you know, the Internet was kind of created by the Department of Defense. How about this thing? We don’t know the answer to that but it’s a key question because we can build a great system but we’re not sure, if you believe it can be a great system, we’re not sure anybody would actually use it. If nobody uses it, it’s not a great system. So figuring that out is important. There were some arguments by National Academies' members whether or not this was technically feasible. I’m less concerned about that. It’s just an issue of people not being able to see beyond their noses. And as I said, you know, what’s the minimum level of effort to test the viability? What’s the least amount that we can do to see if this is going to have traction? So that’s my airplane ware and, you know, airplane ware, typically about 80% of it is raw but is a good starting position to begin to think through what the problems are.

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GOLDHAMMER: Gilman, would you also just walk us through, as a way to start here, this?

SCHWARTZ: Jessie, three other people came into the room.

GOLDHAMMERGOLDHAMMER: Yes. Let's do quick introductions for folks who just arrived. Thank you, Peter.

VONOG: Hello. I'm Stan Vonog. I founded two startups here, currently second and Gilman is an investor, his venture firm is an investor in our startup. And I come from Ukraine and I was educated in Russia, mostly at the Institute of Physics and Technology. And I won a couple of software design competitions worldwide and presented to many people like Bill Gates, etc. in Russia, all kinds of cool technology. So I'm very interested to be here. It's all very interesting and I'm excited.

GOLDHAMMERGOLDHAMMER: Great. Who else joined us? Yes?

CULPEPPER: I'm Mark Culpepper, Chief Technology Officer at SunEdison. We basically do distributed generation of photovoltaics (PV) systems on commercial government utility rooftops. My background, my agency degree is international economics. I've been in technology ever since college primarily in infrastructure, what I would call lightweight infrastructure, so data communications, telecommunications and then transitioned from that into disruptive generation and PV about four years ago.

GOLDHAMMER: Great. And one more? Lynn?

CARUTHERS: Oh, hi.

GOLDHAMMER: We'll introduce Lynn in a moment. Hang on, Lynn. Gilman, would you mind -- We're going to use this as a basis for some of the discussions. If you could just give us a high level description of what this is, perhaps answering some of those questions, that would be very helpful.

LOUIE: So let me kind of back up. One of the challenges we had when we did our first draft report from some of the monitors – monitors are kind of like people who review your paper to see whether or not it's publishable, every much like submitting your work as a Ph.D. candidate and we do have peer reviews. It's a very important process. And so one of the concerns that the reviewers had is, you know, this is really interesting, provides a great background but, you know, you haven't given the readers enough of a framework to think through how you would even go about building out a system to accomplish the goals that the committee wants to accomplish. So one of the recommendations is to put together a flow diagram or traditional block diagram, you know, one or the other or some hybrid approach, that basically describes what you're talking about. So let me start off by saying the following. This is raw, okay? So please don't take it too seriously. We understand that it's raw but – and let me explain why we think it's raw and then why we think it's still valuable. In the old days most of you -- about half of the room can remember. In the old days computer systems used to be batch operations. You used to take a pile of cards, used to submit it down in the basement of some building somewhere, a bunch of geeks would load it up and the next morning you'd get your report, right? And so when CRT started showing up, or even Teletype 33 started showing up – you've got to be really old to remember what the Teletype 33 is, but when those started showing up people started thinking about gee, you know, this computational environment, this real

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time kind of persistent computing environment, it's a lot different than the batch environment. So how do we think about that world? So one is to leap ahead and say well, you know, now that we have kind of real time computing we should be on the cloud, there should be all this stuff, it should be persistent, it should be everywhere, right? But if you were sitting in that basement, all that would be gibberish, right? You wouldn't understand what you're talking about. So what we had to explain to people back in the batch days was real time systems was really batched but just done really, really fast. [General laughter] Something you don't have to change too much about how you think about the problem. You just need to use the same methodology. You get that white and black book that IBM published about system, design your system, flow charts that they published in the 1970s, and it's still the same thing but we'll do it maybe a hundred times a day rather than one time a day. But don't worry. Nothing will change. Your life won't be too different. This is that version. Life will not change forecaster, Ms. Forecaster. We're just going to do it many, many times really, really fast, okay? So we understand that that is a lie but it is a useful approach to think through the problem. So in the traditional approach of forecasting we said to ourselves, you know, you've got to really define the project. What's the mission, why are you even doing this in the first place? Now we all know when you build a system like Wikipedia or, you know, any repository of information out there or you're doing Google, you know, trying to build a search engine, right, you don't say well I'm going to build a search engine that's really good for scientific discovery. You know, those kids kind of start off in [mike noise] but for us old farts we like to think about Manhattan. We've got to figure out who your users are. So this is kind of like kind of the nod to a good forecaster would start off with the idea of who your users are. Now in a 1.0 version of the world it is useful to figure out a small sliver of a target market that may be representative of a bigger market to see if there's any value even for that small market to begin with. So kind of think of this as vertical segmentation of a big idea for all you new farts and for all you old farts, not that much is different than the way you did forecasting in the past. Okay, so once you kind of define what the priorities of the mission, which is if you had this forecast what would you use it for, right? Understanding the use of the forecast, how they will apply that forecast, critically important because if the person is trying to allocate resources because it's a financial decision, right, versus a human decision or I just don't want to die tomorrow; I'm not trying to maximize my opportunity, I'm trying to minimize my likelihood of total, complete utter failure and produce a different kind of forecast. Second, you've got to go off and then figure out given those objectives, who has the data, where are the sources of data, where are interesting data that I can get in touch that might be useful to inform a forecast? There are data feeds and people feeds. We thought that was really important because any automated system needs to be able to ingest data in a way that computer systems can maximize and use, but there's also people, kind of like this. This is a disruptive technology. [General laughter] [Comments] Can we start later, please?

UNKNOWN: Actually it's a destructive technology. [General laughter]

LOUIE: As a feedback [Multiple Comments] It'll come back in five minutes. It'll be really short and then it'll come back five minutes later and be really, really short. Okay. Once you've got to go through the data – you know, traditionally you have to go through a data hygiene process that's either restructuring the data, cleaning out. Now we did have an insight that even bad data is useful in a forecast, right, because it begins to inform you of where kind of conventional wisdom is falling. So the big mistake about data hygiene in forecasting at this point is you start biasing it by saying this is useless data so I'm going to ignore it. So you want to be able to take any data, including bad, what you might

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consider bad data, and still be able to present it in a way that will inform you what the world might become or what the world thinks it might become or why you may be wrong. Then a bunch of processes that you would go through to crunch through all of that data, including the employment of forecasting methodologies in the analytical phase. Once that is done you get to an output. The output should then allow somebody to look at the portfolio of possible futures, not necessarily probable futures, spread your bets against that environment, allocate that resource and then the feedback is track it, see it and then do it again and do it many, many, many times. So again, I apologize. This is a lie but it is a useful framework to think about, okay?

GOLDHAMMER: Thank you. So this is the Noble Lie, which we're going to use as the basis for our discussion today and it's actually important to provide us I think with some structure to be able to think about what product 1.0 is going to look like. What I want to do is just use that as a transition now to dive into some conversation about some of the key design challenges that we face in thinking about a persistent system to identify disruptive technologies. Now these design challenges that I want to talk about are ones that we have sort of observed in our own experience helping organizations and governments in particular design systems like this. And at different junctures in the system there's some really thorny, tricky design challenges that are worth talking about before you actually get down with pen and paper or in this case, shapes and paper, and start figuring out what are the different elements of this system and how do they fit together. So we're going to again use the Noble Lie here to process steps, identify a set of process steps which no matter what system we ultimately design we're going to have some set of these steps. At some point you have to define what are we looking at or what are we not looking at. What's in, what's out. What are we actually, what kind of information are we actually gathering. Is it open source, closed source. These are things that at the high level we have to do. Now we also have to think about some key design challenges, defining the unknown. So if you have to define what's in and what's out, how do you do that when you don't know exactly what you're looking for? When you're collecting information and there happens to – as I'm sure someone has probably on the tip of their tongue how much information is actually in existence on Earth today, exabytes of information, we're talking about a lot of information about a lot of different kinds of not only technologies, new and old, but also information about the ways in which those technologies are being adapted in different parts of the Earth at different moments of the day. It's a lot of information and one design challenge is how do you avoid data overload. You can't have it all. How do you gather outside perspectives when you fundamentally are designing a system that's going to be used by, in many, most likely by a U.S.-based organization? One key question here that we've run into in many cases with clients that we've worked with is how do you synthesize data into narrative. You've got lots of information about lots of different changes in disruptions that are happening around the world and as Gilman pointed out, you may have a normative set of changes which everyone basically says yeah, we need to look at nano, we need to look bio, these things are really important. They're going to change the way in which we live. It's five years, it's ten years out. This is going to make a big difference. And then there's this other stuff in the tail and no one wants to believe what's happening in the tail. That's why it's in the tail. And yet you have to be able to find evidence of some sort in the world that what's going on in the tail actually matters and you have to be able to tell it, you have to tell it in a story or in a narrative that is going to get the people to actually make decisions or take actions now to prepare for those changes in the future to do it today. It's a really, really hard thing to do. The final design challenge is communicating to key stakeholders. Once you've actually figured out what you're looking at, how you put it together and the story you're going to

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tell about it, how do you get people to believe it? How do you get someone to say, "You know what, you're right. That 15 years, it's going to be 15 years out, but we need to do something today," when they have a million other competing priorities? And so a system that's going to generate this kind of information and we also have to think through how is it generated in such a way that you can actually use it, that the person at the other end of the stream or at the other end of the narrative actually has a reason to believe that this is something that they need to care about. So let's start with the defining of the unknown. And now I want to open it up to all of you. To the extent that this is a design challenge, how from your own experience have you dealt with this challenge? Can you share with us any ideas or thoughts about how we can define the unknown when we don't know what the unknown is?

UNKNOWN: So just before I answer your question directly, let me just capture a thought that I had in response to a specific question that probably comes a little bit later. But the question was about experts versus crowd. And I'm going to suggest that there's another choice besides the experts and the crowd and let me call it the generalist as opposed to the expert. And what I found is that I don't get good results by going just to experts. But if we add generalists, the results get better.

GOLDHAMMER: Okay.

UNKNOWN: Okay? So now in terms of defining the unknown, I would go after – again, there's a technique, it's a brainstorming technique. You need to seed it but it's very important that it be pure brainstorming and invite extremes. So we typically ask things like what will things be like 100 years from now, 200 years from now, 500 years from now? I mean, we really push because otherwise when we ask the questions, whether it's expert or not, we get what will things be like a year or two from now, okay? So that's a piece.

GOLDHAMMER: Great.

SCHWARTZ: Stretching the timeframe, in other words.

UNKNOWN: Yes.

GOLDHAMMER: Yes.

UNKNOWN: Well in going through this process in the past, technology, people don't buy technology for technology's sake. It's always solving some fundamental problem and I think, you know, it was brought up a little earlier, it's, you know, somebody, the problems here and the problems somewhere else in the world are different. And I think a big part of it is figuring out what are the fundamental problems that people are trying to solve? Because that's where money gets allocated and that's where technology gets implemented, and trying to figure out okay, what are the fundamental differences? And then it's a matter of doing a scenario problem. What could the potential outcomes be? And then you get into the whole notion of okay, in that scenario, what are the viable technologies for that, and exploring what those options are.

GOLDHAMMER: That's great. So recognizing that people are solving different problems and they're solving them in different ways in different parts of the world. I just want to just pause for a second and also I wanted to give Lynn a chance to kind of get onto the board what exactly she's going to be doing for us over the course of the day, which is recording

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our thoughts rapidly. And I also wanted to pause just to remind everyone that if you can speak slowly and also if you can at the end sort of sum up what your point is, this is very helpful for Lynn to be able to get your idea onto the page. And so let me just introduce Lynn Caruthers, who's going to be recording for us for the rest of the day.

CARRUTHERS: Good morning. And if on occasion, if you have a great long thought, if you breathe -- [general laughter] -- I would be grateful.

SCHWARTZ: And if it doesn't get up there quite right, Lynn is quite capable of fixing it so go up and tell her, you know, "I didn't actually mean 'fundamental', I meant 'irrelevant'," you know.

CARRUTHERS: All right. This is to be a reflection of your conversations today. It is not ours. It's markers and tape.

UNKNOWN: Does this turn into like a printout that we get later?

SCHWARTZ: Yes. We take pictures of these and shrink them and you can actually read it and it's a good summary of the day.

SCHWARTZ: Yeah.

GOLDHAMMER: Yeah. Phil?

NOLAN: I wanted to pose a question about unknown to whom and if we have a set of, for example, analysts in the government, there may be a vast number of things that are unknown to them that are actually broadly known in another sector. And it makes me think of a few math classes I took around infinity and there were many different kinds of infinite sets and I think in a similar way there's many different kinds of sets of unknowns. And spending a little time in advance to try to figure out what are the unknown sets that are of interest to us can be very helpful.

GOLDHAMMER: Yeah, Jenny?

HWANG: I just noticed that the dialogue here may be to have this thought. That is the design challenges I think has one very fundamental thing. That is how to formulate the questions. I can see the question proposed – I just immediately saw how you responded to it. But the question is formed a different way, you will respond differently. I think that's probably a very formidable challenge, is really what to ask, you know, how to formulate the question.

GOLDHAMMER: Right. So Jenny's point is it's fundamental to think about how people, what questions people are asking and how people are asking those questions, which gets to this question of defining the unknown. Yes?

SCHWARTZ: So I think that we have discussed this in the committee. Actually Steve was one of the ones who did it in the committee but if I could paraphrase what I remember, is that it's not just the technology, it's the application and the use. That to some extent defines the unknown. We don't know how somebody else is going to use it. So for me that is the most important component, the usage paths.

GOLDHAMMER: It's the usage and adaptation of the technology that may already exist. Great. I think Stuart had a point and then Peter.

BRAND: I'm most interested in catching positive feedbacks early and so what Gordon Moore did way back when it was Moore's conjecture was that, you know, the number of processors on a chip was going to double every couple years and that that was going to be important. It was really just a business plan. It was classic pitch deck stuff. But then other people, Negroponte at MIT said well if that's the case then personal computers are going to defeat minis and all these other things will happen. We'll try to get out in front of that. And he allocated a bunch of MIT resources to get ahead of that work. Metcalfe's Law, that networks multiply their effects way more than just the number of nodes that you add. And so from that you could have predicted that when cell phones went into the developing world they would explode and change the world. The tricky point about positive feedbacks is it's real easy to identify them once they've changed the world. What you want to do is identify them back when Gordon Moore did when -- doubling is not a very big event, when you go 2 to 4, you know, so what? You know, we're looking at thousands. What's going on here? And there's lots of them that will get to 2 to 4 to 8 and then stop so you want to try to identify the ones that have a self-acceleration that keeps going and has impacts along the way that then feed it, which is what happened with cell phones. So that's what I would be looking for, is where are these things just starting to just show the tips of their ears in taking off.

GOLDHAMMER: That's great. Peter?

SCHWARTZ: I think another way to get at the question of unknowns is to think about the impact end of it and this goes to, you know, Gilman's list, one of his several lists, but of what we want at the end. We want to know those things that are really going to make a difference. So the question is what makes a difference? In other words, what are the kinds of differences that matter, whether they're balances of power, capabilities that people will have that we don't have, abilities to see things we can't see and so on? So what are the classes of impacts that would make a difference and then work back upstream to see how would you achieve those impacts and where would they be achieved? And that leads very directly to a point that I think Stuart has made several times in other contexts, that if you're thinking about the impacts – and this also goes to the point about problem solving – then you start looking at different ways that people solve that problem. So for example, folks in favelas who don't have resources and who have to innovate from the bottom up, as it were, to invent ways to get power or healthcare or communications or whatever it is that they're in fact stealing, organizing, reorganizing and so on and reinventing. So it's that sense of what's that impact from the bottom up that enables these people to recombine technologies to create new capabilities. And I mean, the IED is a classic example of a favela solution to a problem.

GOLDHAMMER: And a very effective one at that.

SCHWARTZ: Yeah.

GOLDHAMMER: Yeah. Any other last comments on this one? Yes?

TWOHEY: I think in a disruptive technology shouldn't it be an output rather than an input? Why are you trying to define that node? Why don't you wait for it to merge in the [Mike Noise].

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GOLDHAMMER: Okay. Say more about that. So if it's an output then what's the input.

TWOHEY: Oh, the input is the situation. I mean, it can be like a collective knowledge of different groups of people, right? And then the output would be some sort of refinement of that.

GOLDHAMMER: Okay.y, great. Great. And then we'll come over to Jenny.

WINARSKY[?]: Just following up on that, turn it around and also following up on what Peter said, take the impacts, take the visions with their potential impact and talk about how much we know about those. Measure not just the impact but the amount of knowledge or the relative amount of knowledge. So do we know very little about how we might achieve that impact, do we know a lot about how we might achieve that impact? But we're not going to the unknown directly. We're saying knowledge based is one way we should be measuring what we are dealing with systematically.

GOLDHAMMER: Great. Last comment on this challenge and we'll push on.

UNKNOWN: I think something that was in the initial presentation that we want to look at is identify and track the heretics. Find those people that are on the lunatic fringe. I mean, you could make a great argument --

UNKNOWN: I'm right here. [Laughter]

UNKNOWN: Well most of them are in this room, yeah. But I mean, you could make a real good argument. For example, Bill Gates. You know, the entire hacker community hated Bill Gates when Bill Gates wrote a treatise and said, "We have to be able to either patent or license software." Now everybody hated the idea but it has had an impact on the way software has been developed ever since. And it was a radical idea at the time but…

GOLDHAMMER: Identify the heretics. Great. So avoiding data overload. There's a lot of data out there, a lot of information. We just, even in defining unknowns, a lot of information that you would want to collect, identifying heretics, for example. How do you manage this problem in a system like this?

SCHWARTZ: Well I think part of the design challenge is avoiding the issue of the light, the key under the streetlamp problem. That is, you know, we all know the old joke of the drunk looking for the keys under the streetlamp because that's where the light is, and it is the case that we have a tendency to focus where the light is. And so I think part of the challenge for us is – and I don't have a good answer, okay -- This is a problem and the problem is that we have a tendency to look where it's easy to look as opposed to being able -- And that's how we avoid the overload problem. We say all right, let's just focus on those things we can just get at. If we actually looked in all the places where the keys could be, we really would have a data overload problem. So getting that right is I think one of the hard things.

GOLDHAMMER: Yeah. Gentleman over here, go ahead.

DREW: Steve Drew. Just a thought on that comment that you just made. It's not just looking under the light. It's deciding where in the architecture you're going to look. Earlier today we talked about problems and issues and I imply from that that problems and issues give rise to vision, see that problem as not a problem. So do you start looking at the top of the mountain of data and you say I think the visions are, I think the problems are? Or at the other extreme, do you start looking at the fundamental disciplines at the base of the mountain and then ask each discipline what –

[TAPE INTERRUPTED]

LONG: …method that can determine what's good information and what's nonsense, I think is going to be very, very difficult. You really need a smart person and even smart people can be deluded into believing things that are just wrong. Zero point energy, for example --

SCHWARTZ: Good example.

LONG: -- brings a lot of money in from naïve people by unscrupulous scientists and you're not going to have an automatic method that can tell good science from bad science.

GOLDHAMMER: Yeah, good point. Yes?

WINARSKY: So this has been said in different ways but I'll just try and summarize. First of all, there's two kinds of data we're talking about. One is disruptive technologies and the other one is what could be done with it and you could almost start from the other way around. What are the disruptive events that could occur and what are the solutions to creating that? And if you do it wrong, you have massive data overload. So if somebody invented a passive imaging system that detected the vibration frequencies of a surface at more than a hundred meters, that's potentially a disruptive innovation. Why? Because somebody could be imaging this window and hearing everything we have to say in this room, okay? The relationship between a technology and what it might enable is extremely difficult. That's what venture capitalists are always trying to figure out as well, you know, what does this venture do? I mean, don't tell me about his technology with these many gigahertz, and this kind of storage. Tell me what it can do. So let me just complete the thought by saying I would avoid data overload by starting with the futures that we predict could be the difficult or possibly problematic futures and then engage in what are the solutions to those futures.

GOLDHAMMER: Great. Last comment over here and then we're going to push on.

McCORMICK: I just want to add to what you're saying. I think there's two paradigms at work. One of the things that are a little bit sort of disconcerting in listening to some of the things we're talking about here, first you start talking about disruption technologies and all of a sudden it implies that we're trying to solve a problem. The reality is most of the change in the world comes from an opportunity, you know, people looking for some kind of economic gain, some kind of difference, which always implies a context. What's economically viable for you isn't necessarily what's economically viable for me, which isn't going to be what's economically viable for another country in some way, shape or form. So I think we have to be really careful with the context that we choose and how we're looking at it because in reality most things don't happen unless there's something to gain, you know.

GOLDHAMMER: Great. "Gathering Outside Perspectives," another interesting design challenge. Outside of what, whose perspectives, how are they gathered, how do you make sense of them? I mean, right now we're in the process of gathering outside perspectives. Is there any coherence that just is intrinsic to the perspectives that are being articulated in this particular meeting that one could easily make sense of and insert into a system that identifies disruptive technologies? Not an easy equation to solve. You want to pick up on that, Al?

SAFFO: Sure. Just move it back one slide. I want to make one observation.

GOLDHAMMER: One observation.

SAFFO: How many of us know people whose offices look like that who are absolutely brilliant at forecasting? I think this is a photo of Esther Dyson's office. [General laughter]

GOLDHAMMER: I'm going to Photoshop Esther into this. [General laughter]

SAFFO: She's under the second pile. [General chuckles] It fits with -- a model I follow as a forecaster is strong opinions, weakly held, come to a conclusion as quickly as possible and then attempt to destroy it yourself before somebody else does. And I think the lesson is make models early and then kill your children.

TWOHEY: I have a question. So what – for outside perspectives, was anybody, did anybody have the perspective that Napster would come along and totally tank the music industry? Did anybody around say, "Yeah, some guy's going to put a bomb in a shoe box" and that's going to go kill a lot of our soldiers, right? Was there anybody around on earth that had this thing before it happened just because there is -- have we done any analysis going backwards? I mean, clearly Mr. Brand wants to go. [General chuckles]

BRAND: I did -- Yeah. In 1972 I went to the Stanford AI lab and saw that they were passing information around and put it in a book called *Two Cybernetic Frontiers* and in there actually said goodbye to the music store.

GOLDHAMMER: So I guess the answer's yes at least on that particular issue but the point is, very well taken. Yes?

ZYDA: I think there's a fundamental flaw in what we're trying to do here today and the fundamental flaw is you're trying to come up with a process that helps you predict disruptive innovations, whereas the truth of the matter is the stuff that happens happens and then we all go "Wow, that's really cool." But if you go find those people, they didn't go through regular VCs and regular government funding sponsors. You know, when they went to the government funding sponsor at DARPA they probably got kicked out the door, you know. So I think there's a flaw and so, you know, when -- and the flaw being that if you took some of the crazy ideas -- if you backed up and said -- Let's take the music example. "I'm going to -- music is now going to be digitally distributed." You know, we started seeing that with the first iPod in 2001 but did people really believe that was going to close all the music stores? Probably not, until much later.

GOLDHAMMER: Harry.

BLOUNT: Yeah, I think one of the key things with this outside perspectives – and if we look at the financial markets it's a perfect example. Wall Street spent billions of dollars building tight algorithms to correlate all asset classes because they had forty years of financial data and they basically started with the assumption that if you have enough data, enough history, you can hedge away all risk. And that worked really well until it didn't, which was two years ago. [General laughter]

LOUIE: Then it really didn't.

BLOUNT: Two years ago, but if you asked somebody in the mortgage business, “Hey, is this a good idea to give loans to people that have no way of repaying?” they would have told you that, you know, we’re setting ourselves up for a large disaster. So that’s probably one of the largest examples looking for outside perspective. Now the question I think boils down to the experts versus the crowd, and on that front I guess one of the things I’d like to offer up is I think given the search technologies, the social networks out there, it seems like you can ask really basic questions among a lot of different perspectives and a lot of different groups and get feedback relatively quickly.

GOLDHAMMER: Mark?

CULPEPPER: Yeah, you know, the thing that I think about is kind of historical elements that at one time were considered disruptive but now we just completely take for granted. And they’re so taken for granted that they’re literally invisible to us. I had the opportunity to drive across the country about a year ago, my family and I, we took about ten days and, you know, never once did we run out of gasoline, never once was there even a question of whether or not the roads were going to be good. Everything was just there and it was literally to the point where everybody assumed it’s going to be there. And I think one of the ways to get good outside perspective is to look at things today that we take for granted that are just there and say, “When did that happen?” Because that didn't happen just overnight, that happened literally, in some cases, over decades. And the way I look at this and the perspective of something that’s truly disruptive is take a look at things like how did the dams get built and why, right? I mean, a great book, *Cadillac Desert*, that talks about that whole dimension, you know. A lot of these things I think that have great historical context for where we’re at today, give us a view on how disruption occurred in the past and it occurred and then it became invisible.

GOLDHAMMER: Great. Bill?

MARK: So my bias, which has been expressed several times by other people, is that the disruption occurs in the use of the technology.

SCHWARTZ: In the use?

MARK: Use of the technology. So that makes me think that there’s – in this recent conversation there’s been too much emphasis on opinion and gathering opinion, whereas, in fact, there’s experiments going on all the time in various uses of technology. So Napster came up --

SCHWARTZ: Perfect example.

MARK: And this came, this also comes back to the, you know, unknown to whom. So there were a bunch of people, mostly college kids, who knew all about Napster very, very early. So if people were tuned into that experiment going on, perhaps they would have been able to tell. People are using their cell phone minutes to buy things and trade things, right? That’s an experiment that’s been going on for a number of years now and that’s leading

Transcripts were not edited.

to some pretty spectacular stuff. Early identification of interesting experiments going on I think would help us understand the disruption.

GOLDHAMMER: I think that's great. One last point. Peter?

SCHWARTZ: Yeah, and I'm just following up on precisely that point and it goes to one of the biases we argued earlier, which -- we said go young but I would say go to those people who are most likely to be the users of things that we – not necessarily – we don't know what they're going to do but the people who for one reason or another are not able to use or don't want to use the conventional approaches to solving the problems that they have like getting access to music, for example. And the interesting thing that one sees in say the Napster/iTunes case is that the real surprise in it was that it was Apple Computer, not Sony, that -- And it ought to have been. In fact if you looked at the case you'd say, "Ah, Japan's going to win this war, Sony's going to win this war. They're going to reinvent the music business because they got the music, they got the MP3 player already, they've got the systems, the distribution. They should create this." And of course what you saw was a conservative bias that said, "No, no, we don't want to let go of the old business." It took essentially new players out at the edge of the business that weren't involved to reinvent it. So that sense of where is that reinvention going to come from is I think the great challenge in how do you get that external perspective, how do you find the right people to be asking, in a sense, who are going to use the technology in new ways, because Apple didn't invent anything there.

BLOUNT: Yeah, so maybe go broad instead of go young, is maybe what you're saying.

SCHWARTZ: That's another way to put it, yes.

UNKNOWN: I mean, this is a classic paradigm shift.

GOLDHAMMER: Harry, can you repeat that so we can capture that?

BLOUNT: Oh, I said so what I think I heard Peter say is go broad instead of go young.

GOLDHAMMER: Go broad instead of go young. Great! Just finish here with Phil and then we're going to push on.

NOLAN: Just want to call out something I've heard that seems implicit in a lot of our discussions about getting outside perspectives. They're costly, they're costly the old-fashioned way, which is, you know, we're talking about putting people on planes and making sure you have good translators and so on when you're in a different country. They're also either socially costly, you're going to the heretic, you're going to an outcast person or you're going to hang out with the 18-year-old. It can be emotionally costly, the person who has that perspective and idea is a flaming asshole who you don't want to be around. So in some ways –

GOLDHAMMER: Did we capture that, by the way? [General laughter]

SCHWARTZ: I get a lot of letters from those guys. [Laughter]

LOUIE: It's called the asshole theory, and says you can take all the billionaires who made a billion dollars or more from the very beginning and made it all the way through the other end, almost everyone's an asshole, you know, Gates, you know. You can go through all the list, you know, Ellison, you just go boom, boom, boom, who made it all the way through, most of them are assholes.

GOLDHAMMER: A lot of energy around that. [General laughter] All of this is going to be searchable on the Internet. I'm just going to warn all of you. You're on the record.

GRAY: You can call it a personality type.

CARRUTHERS: Somebody tell me what the name of that book was?

CULPEPPER: *Cadillac Desert*.

CARRUTHERS: *Cadillac Desert*. Thank you.

GOLDHAMMER: *Cadillac Desert*. Great. Synthesizing data into narrative. All of you, my guess, in your different roles, different professional capacities, have been in a position of having to tell a story to someone who either controlled power or resources about a disruption that was coming or perhaps that you were bringing and were trying to get them to see the world in a different way. It is not an easy thing to do, especially when you're blindsided by it. You've got a particular worldview and all of a sudden someone walks in your office and says, "Everything that you believe is wrong, everything that you believe is wrong, and the world is in fact going to look this way." This starts to get at that issue, which is now synthesizing data into narrative. Any thoughts about how you take expert opinions, data that gets collected through search engines, different kinds of pieces of information about either how people are using or adapting technologies or new technological developments, how do you pull that together into something that is coherent? Yes?

SAFFO: Never let the facts get in the way of a good story. Yeah, it's the engagement of strategic misdirection, being intentionally misleading in the service of provoking creative thought.

GOLDHAMMER: Great. Al, yeah.

VELOSA: I think also wherever possible avoid decimal points. [General laughter] One of the things that actually is a very big initiative generally is actually is to get rid of actually publishing a lot of numbers. Actually just publish the assumptions. Because at the end of the day there's a story behind it – I'm going to quote you there, Paul – that's a much more interesting proposal. Because they're going to believe or not believe your numbers anyway but they want to know how you got there. So the narrative of how you got there is the most important thing on any forecast.

GOLDHAMMER: Great. Let's do Ray, Mike and then Stewart. Go ahead, Ray.

STRONG: There's a very standard technique that comes under a lot of different names; I'm thinking implication wheel. And it's something that can be facilitated by a system so it can be done systematically and it is just that. You know, you start out with some central vision and theme and then you say, "Okay, what are the implications?" and you ask in various aspects, you know, speed or social, political, economic and so forth – you ask all those aspects. You run around the wheel, you get new centers, you expand out and the system can actually keep you balanced so that you don't go too far in one direction nor the

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others. And that’s directly answering the question: How do I synthesize data? Because you can have a system asking the questions and filling them in.

GOLDHAMMER: Great. Yeah, Mike?

McCORMICK: I always say there’s four fundamental questions: What’s the value? Where are you going? How are you going to get there? Why are you going to be successful? That’s what the story’s got to know.

GOLDHAMMER: Okay, great. Stewart? Can we actually just – can you repeat that one more time for Lynn to capture, perhaps?

McCORMICK: Sure. What’s the value --

CARRUTHERS: I’ll put the key words and I’ll fill in the rest in a bit.

McCORMICK: Okay. Where are you going? How are you going to get there? Why are you going to be successful?

CARRUTHERS: Why you’re going to be what?

McCORMICK: Successful.

CARRUTHERS: Thank you.

GOLDHAMMER: Thank you. Stewart?

BRAND: I think that every wrong theory is based on a number of wrong pillars. And so when you’re going to go into your narrative if you start with one pillar that’s really wrong that the person is standing on -- In my case I’m trying to convince environmentalists that nuclear’s good for them, not bad for them. I can start with radiation. Radiation is not as bad for you as you think it is and here’s why and Chernobyl, etc. So if you can get them unsure about one of the pillars they’ve been standing on all this time and let them know you’re going to deal with every single one of the pillars, not right in this meeting but soon enough, that’s a chance to get in the door.

GOLDHAMMER: Gilman

LOUIE: I always tell my associates that “Don’t invest in any technology unless you saw it on *Star Trek* first.”

GOLDHAMMER: Unless what?

LOUIE: Unless you saw it on “Star Trek” first.

GILMAN: Pick an episode, and if you can’t find it somewhere in there, maybe it’s not worth the investment. [General chuckles] And the reason for that is, you know, if you think about writing fiction or writing a screenplay or a television show, you know, they’ve got to tell a story about the human condition. That’s really, really key. It’s a human condition issue. I’m trying to tell a story about the human condition. If you don’t have a human condition in your narrative it’s kind of like useless. What’s the point? The second is in science

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fiction particularly people create technologies to solve problems in the story. In other words, I've got to go from here to here and I can't do it just with human beings and existing technology. I have to make something up. You know, *24*, you know, I've got fifteen minutes to tell the story. I need to make up this grand machine that can go through all the fingerprints in the world and do facial recognition in ten seconds or less because that's what I've got to do on the show. And what's interesting about that is as they are trying to solve their story using technology to take these leaps to tell the human condition, it informs you on what you have to do. So my view is something slightly different, don't believe in any technology where you can't turn it into a story. If you can't make a story out of there that this is an interesting story about the human condition, that'll probably never come true.

GOLDHAMMER: Last comment right here.

WINARSKY: I would also -- and this is almost repeating what we've said before, I'd start with the narrative. I'd start with – and then derive evidence, then move my narrative as the evidence tends to persuade me or others in different directions. And I'd start with somebody who is helping the decision-makers define the problem and I'd find a narrative that worried them the most.

GOLDHAMMER: Great bridge comment. Peter?

SCHWARTZ: Just one quick comment that – well this is in fact a comment on the next topic.

GOLDHAMMER: Yes.

SCHWARTZ: Okay, so it is the next topic literally, and that is that in fact you really have to understand your audience, that it makes a huge difference – When I was head of scenario planning of Shell I spent an enormous amount of time trying to understand the language, culture and context of the people who had to actually use the information I gave to them. And if I didn't understand it I was speaking in the abstract. So the story and the issue that we're trying to get across has to speak specifically to the concerns, fears, aspirations, context, mental maps of the people that you're actually trying to influence with it.

GOLDHAMMER: Yep. Mark?

CULPEPPER: Yeah, just to follow on that, I think that it's, you know, I like to say every sale is ultimately an emotional sale, right, there's got to be an emotional hook. And I don't care if you're selling computers, routers, network switches, PV systems, whatever. You know, so if you don't have an emotional hook when you're communicating, your odds of success go way, way down.

GOLDHAMMER: Yeah. I mean, one thing that I think is sort of amazing is just the conversation we're having around narrative and stakeholders is, to me, in at least my humble opinion, the most profound thing we've been talking about this morning, in part because the capabilities required to do that well are actually quite different than the capabilities for gathering information, collecting information, synthesizing information, all the kind of technical requirements that go into what's going out in the world from a technology and adaptation perspective. And then the ability to actually pull that together into a compelling, emotional narrative and to do that in a language that stakeholders are going

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to understand so they actually take action and make decisions differently than they might otherwise, that's quite profound.

LYBRAND: So would that mean that you would want to recruit from your stakeholders as you build this platform so that you're building out people who already speak the language?

GOLDHAMMER: Quite possibly.

SCHWARTZ: That's interesting.

GOLDHAMMER: Ken?

PAYNE: And I think this – as a person who is non-technically oriented, having worked with scientists and engineers on a regular basis for like the past twelve years or so, that's one of the hardest things to do when we go up to seniors. And I see their slide deck of 50 slides and they've got an hour and I start pulling out about 45 of their slides saying that they don't care about this, you know, especially in our world, the intel world, they're mostly – you know, as they're called, soft science majors or fuzzy science or whatever they call it. They don't care. They want to know why they're important, they want to know what's the consequences if you're right and I don't listen to you because they're either political appointees or work with political appointees, you know. Because that's like "As long as I'm good during this administration era, okay, I'm good to go." [General laughter] "But if something's going to happen to affect me before the end of that administration and I'm going to end up looking bad, then I'm concerned about it." And it goes back to knowing your audience and stakeholders, which is difficult. You know, and when folks go up there and they have to talk to seniors and they have an hour, you know, I can barely try to convince them and it's hard because they put all this work into it and they have all this great data and a bunch of decimal points – [General laughter] – they have all this stuff, and I say, "You need to cut your presentation down to 40 or 45 minutes." And they say, "Why?" I say, "Because somebody's going to brief that person after you and the questions that they have are going to be answered by somebody else or through somebody else. And so if you leave that 15 to 20 minutes at the end, you can answer the questions with the technical data if they ask for it or with the emotion that they need." And that's the difficulty in the government when you do that because you've got some different -- People aren't in it for the money, necessarily, they're in it for, "Okay, I'm going to say I serve my country or I want this political connection" or "Hey, I probably wouldn't have this level of importance if I were outside the government."

GOLDHAMMER: Thank you. Great point. Mike?

McCORMICK: I actually want to come back to what Mark was talking about earlier. I'm sorry. I agree. I mean, people buy wants, not needs. But what worries me about this discussion a little bit is if we're talking about pitching this to, shall we say, higher ups, it's not the wants of the higher ups that matter, it's the wants of the individuals that are creating that disruption. So the context of what you're talking about, the selling – okay, this is the life of what they live, you know, that's going to create this dynamic change. And having it so it's relevant is I think a harder point of the actual discussion. Because let's face it, if you live in the myopic world – excuse me on this one – of Washington, D.C. at times, you know, you don't understand the fact of what's going on in the rest of the world and the implications of that.

GOLDHAMMER: That's right. Steve, Steve, did you have a comment?

DREW: Yeah. This may be a weird thing to say but maybe we're headed at this the wrong way or maybe there is an alternate way to think about it. I think it was Norman who said do the narrative first and then fill in from behind. Maybe what we should be looking for are the long-term successful narrators, not the --

SCHWARTZ: Narrators?

DREW: Narrators.

SCHWARTZ: The storytellers.

DREW: The sources. Who weaves successful stories time after time after time that are technology built and how did they weave that? What was it about their thinking that captured that future to come in the basic technology?

GOLDHAMMER: Peter?

SCHWARTZ: Yeah, this is going to –

DREW: A little strange but…

SCHWARTZ: No, I think your point is well taken and it goes back to actually Gilman's comment about *Star Trek*. Several of us in this room had the experience of helping to create the world for the film *Minority Report* and some of you have seen it. And one of the most significant things about the film is how many times clips from that film are now used to communicate new products, whether it's Microsoft's Table or a new advertising system or new scanning recognition systems and so on. I see the clip all the time. Why did it work? It works because it's Steven Spielberg, not -- I mean, frankly, we had a group of remarkable experts in the room, Neil Gershenfeld, a whole bunch of really smart people trying to tell him what the technologies were and that worked brilliantly. But what made it actually work was Spielberg was the director and he put it in a human context and, you know, everyone remembers the moment in the film, you know, their own particular moment – the electronic newspaper or Tom Cruise chasing his eyeball down the ramp for the optical recognition system and so on. The point being that it is the story in context that actually makes those technologies come to life and has actually probably accelerated the rate of development of the technologies.

GOLDHAMMER: Yes, Mike?

CULPEPPER: Yeah, one thing that I've done in the companies that I've worked with is particularly for startups is create a glossary that everybody can work off of because it's a common language and a framework and everybody then is immediately, [snapping fingers] like you can say something and everybody gets it, right? I don't know if that works in this context but – because you're really taking raw ideas and putting it out there, but if you look at it and you can filter it through some sort of common language – and this goes to what everybody here's really been saying – it makes the communication much faster, much more seamless, just dramatically easier.

GOLDHAMMER: Darrell?

LONG: So I have some concern that we're very Western in our approach here. I had a very interesting dinner with a guy that used to be a CTO of Microsoft in China. And he pointed out to me that these guys work very differently than we do. The senior leadership in China is all Ph.D.s and engineers.

SCHWARTZ: Six out of seven.

LONG: Yeah. They're not run by lawyers. We're run by lawyers and people that don't – they like notional graphs and they don't want labels on their axes here in the U.S.; over there they do. So I'm just concerned that we may be going down a rabbit hole here and talking about, you know, to ourselves when we need to be thinking about how other parts of the world work.

GOLDHAMMER: I agree. Yeah?

TWOHEY: One of the things I guess – The thing was, you know, we're building this technology but part of the process is to put the right people in the right places. So maybe the fundamental assumption here is that, you know, everyone's talking about the current key stakeholders are not going to change. Maybe that needs to change, right? If you have non-technical people that are fundamentally supposed to be interpreting very technical things, maybe that's just broken and that you need to fix that and incentivize that.

GOLDHAMMER: Great. Danny.

GRAY: I think maybe something that we need to look at is identifying the definition of stakeholder and identifying the idea of, you know, who's to gain or what's to be gained. Because you look at a lot of what's going on, you know, in improvised munitions, you know, the military has nothing necessarily to be gained. It's really an application of guerilla warfare that's been around for thousands of years. It's just the guerilla mindset taking what's around you and making something out of it. And so you look at somebody who's in the open source software world, for example. What do they have to gain? They don't care whether they can sell their product to the corporate world and package it to the corporate world because maybe they're in it to impress a girl that's online that says, "Wow, look at this software that this guy wrote." I mean, I know this sounds really absurd to people in this room but at the same time this guy can come up with this huge innovation simply because he wants a date next Thursday night but it gets picked up halfway around the world and it turns into something else. And so maybe we shouldn't put quite so much emphasis on communicating to the stakeholders because not always is the money driving the "What's in it for me?" for the innovator.

GOLDHAMMER: So we just covered – in the last hour we covered a number of different design challenges. Any final reflections now looking at all the challenges together, things that as either a member of the committee or as an invited guest – and I'm speaking to the committee, any sort of higher level thoughts now that we think we should keep in mind as we push forward in the day?

SCHWARTZ: One thing we didn't really talk much about is feedback and adaptation. In other words, this is a system that has to kind of constantly improve itself. The participants and the – both the customers and the active participants need to get better as it moves forward.

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GOLDHAMMER: It’s a learning system.

SCHWARTZ: A learning system. Better way to put it, yes.

GOLDHAMMER: Great. Paul?

SAFFO: Visually instead of a column, it should be a loop or a cycle.

GOLDHAMMER: Loop or a cycle, great. Gilman?

LOUIE: Another thing is if you have a persistent system that’s used globally, the notion of users, forecasters, stakeholders, needs to be all the same. In other words, somebody who contributes to the system has to be able to get something from the system.

SCHWARTZ: What do you mean by “persistent”?

LOUIE: Persistent is something that I can always touch and get to it when I need it not when somebody else – when somebody else either produces it or wants it, where my primary value is answered by the system itself not the secondary value. And I go back to the concept around Wikipedia, right? There are lots of people who put stuff in there, they also are consumers of other people putting stuff in there. So this notional linear triangle concept where there’s just some general with a lot of stars or somebody sitting in a funny white-looking building in the middle of the Beltway, right, says, “I’m more important than everybody else.” I think if we use that as a mind framework, we’re going to have a very unsuccessful system. We’re not going to get the participation and get the usefulness out of it.

GOLDHAMMER: We have three more comments. We have Harry, Stewart, Daniel.

BLOUNT: I think one overarching question that we haven't addressed is the sustainability of the system – to Gilman’s question about persistence. Because one of the things that we’re going to have to think about from a framework perspective is at some point it is going to come down to the question of money and how you sustain this system based on a user environment. So I’m not sure how we work that into the discussion but I think to take it from the theoretical to practical, if we’re really going to quote/unquote build the system you have to think about what is the most efficient way to do it and sustain it long term.

GOLDHAMMER: Great. Stewart?

BRAND: I'm thinking about something I guess I think of as a good tip audit trail or maybe a bad tip audit trail, you know, who are people who have changed my mind, that I'm really glad they did that. Freeman Dyson does that, Manny Nolis does that. Who are people who started to change my mind and then I realized I was going down a primrose path and keep track of who those are, just some kind of way to, you know – This is sort of how judgment’s supposed to get better as you get older because you have more and more of those experiences that you know how to co-weight against each other. Is that a way to – can that be formalized? Well maybe.

GOLDHAMMER: Danny?

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GRAY: One thing I haven't heard discussed is the transparency of openness of the data. When people, as Gilman said, are being involved in this, they also should be able to get something back and that's where having the data being transparent as well as having an openness so other people can get to that data is important.

GOLDHAMMER: It's true.

VELOSA: You know, there are sources of outside perspectives that are free. I mean, if you mine blogs, they're free. And the people that are creating the blogs, they're not involved in the system at all so you don't have to even worry about giving results back to them. And there's many things besides blogs that have such properties.

LOUIE: I think mining is not as free though.

REED: The mine – it's pretty cheap actually. [chuckle]

GOLDHAMMER: So it's just after 10:30. Thank you for what I thought was a very provocative conversation. Why don't we take a 15-minute, no, slightly less than 15-minute break. If we could all be back here at 10:45, we will continue at 10:45. There's food, coffee in the back. The bathrooms are out the doors and any questions, feel free to ask me. Thank you.

TRANSCRIPT OF SECOND MORNING SESSION

10:45 A.M. – 12:00 P.M.

GOLDHAMMER: So in this last segment, in this last morning segment before lunch we're going to dive now more deeply into design criteria. This is going to be a conversation that will set up our afternoon activity where we'll actually be applying these criteria to the creation of an actual version 1 system. And so I just want to say just a few words about why design criteria matter and then we're going to do sort of a quick group exercise. We're going to reconfigure the room a little bit, do a quick group exercise, have some conversations at our tables and then have a report out in about an hour. So first design criteria. Most of you I think, based on introductions, have spent at one time or another designing things so I doubt that these criteria will be much of a surprise to you. But as a reminder, design criteria matter because it does help to focus a system design, to have in mind what you're actually trying to achieve before you put it down on paper will help you get to the Promised Land. It will also help you to figure out and clear tradeoffs and to force prioritization because you can't have everything. And I think we heard very clearly from Gilman this morning that the goal here is not to create the perfect system. The goal here is to create -- don't, in fact don't let the perfect get in the way of the good. We want a good system that actually works without spending a ton of money and without taking a ton of time. And then finally, design criteria are helpful because they insure that the final system can be quality checked against clear metrics. You can actually go back and say, "Did I actually meet the criteria that I set up? Is it doing what I want it to do?" And there are lots of design criteria that we could choose from. What I want to do is just give you one example that comes from work that 360 did with the government of Singapore. So they asked us to design a system to identify disruptive technologies and emerging issues

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and threats. And there were three, I just want to focus on three criteria just for idea generation. So there were different parts of the system. I just want to focus on one here. And Singapore, you have to remember, is of course in a unique context, a very, very small country right next to China, and focused on a set of issues that are sort of unique to their particular geopolitical context.

GOLDHAMMER: Well, not next to China physically but next to China in the sense that that's mainly what they think about. Thank you. And so for idea generation there were three design criteria that they felt were really important. The first was casting a really wide net because Singapore, given how small it is as a country, was a little bit at least from their perspective, a fish bowl from the standpoint of ideas. And so they wanted to cast as wide a net as possible in the design of this part of their emerging issues system in order to sort of hedge against the fact that there may be sort of a, you know, an island group thing. Second, they wanted to focus on creative ideas that have a major impact for the future of Singapore so they really wanted to stretch as much as possible into what Gilman described earlier as the tail. They didn't want to get stuck in the middle. And then also important was they wanted to vary their different ideas of idea collection – vary their methods of idea collection, using the different techniques, formats, media, timing and targets. Now the details aren't really important. What matters is that they spent some time thinking through like given our unique context, given our needs for persistent scanning, how do we want to collect ideas in such a way that we will be able to identify emerging issues that are going to be important for us. This is the way they did it. Now these are the design criteria that are taken out of the first report that the committee generated. They are openness, persistence, bias mitigation, robust and dynamic structure, anomaly detection, ease of use, strong visualization tools and GUI-controlled vocabulary, incentives to participate, reliable data construction and maintenance. Now what's interesting about this is we obviously haven't showed this to you yet and yet just about all of these have come up either in conversation or in the presentation that Gilman gave earlier. So we've already started to internalize these design criteria. Now again, you can't have everything. The world is not perfect. So what we're going to do is we're going to break, we're actually going to take Peter's table and we're going to disperse you at the other three tables. It's going to be step number one. Step number two, you'll see at your table – please don't go anywhere yet – but you'll see at your table that you have some dots. These dots are in the center. Everyone gets five dots. Now there are more dots. You can't cheat. There are actually more dots than five per person but you get five dots. And then you'll see that we've given you these design criteria on a template for each of these tables. And what we want each of you to do is to allocate your dots across these criteria. You can allocate all five, if you want, to one because you think it's the most important or you can distribute your dots across the different criteria. All we're trying to do is get a sense on a table-by-table basis, of where the group is with respect to these design criteria. You may discover at the end of your dot-loading exercise that you actually have dots across all the different criteria, but what we're interested in primarily is the weight. What design elements do you think are the most important as a table, because those are the elements that are going to guide the construction of the system later this afternoon. Now my guess is that after you vote and after you vote to determine sort of where the group is with respect to these design criteria, you may identify additional criteria that you think are critical, you may disagree with some of these criteria. Gilman already told us this morning that we should take as kind of "noble lie" the sort of conceptual model that was developed in a previous report. That's okay too. But the table has to agree upon either what criteria they're going to use for the afternoon or what criteria they're going to add. So once we break you into groups, why you do the dot-loading exercise. Your facilitators will help you have a conversation about sort of where the table is and then why don't you discuss those criteria and start to think about how would you actually use those criteria as a way of building a system, what is the linkage between the criteria themselves and the actual system that you want to create. Are there any questions about what we're going to do just until noon? Okay. So first step is -- yes, Peter?

SCHWARTZ: One thing that isn't there, and I turn to our sponsor for a question, cost isn't up there.

DREW: Yeah.

SCHWARTZ: So money as a constraint is not there. How do we think about that as a design criteria?

GOLDHAMMER: Great question.

[Simultaneous comments]

PAYNE: I don't think it really should be up there.

SCHWARTZ: Pardon me?

PAYNE: I don't think it really should be up there because I think the importance should – doesn't always – define that given that in the government, I mean, we do have a lot of assets we could put towards something if we feel like it is important.

SCHWARTZ: So in other words, we should think about this in a sense unconstrained by the financial limits -- you know, recognizing, you know, within plausible -- yeah, okay.

GOLDHAMMER: Steve?

DREW: I think that might be a mistake because the reality we all live in is balancing impact against cost. I mean, almost Gilman's opening statement said something to that affect. You know, we're not – perfect would be wonderful but we're really looking for maximum impact at some minimum cost value. And so to take that off the table runs the risk of having us not realize the realities of life. Frankly, I'd like to see some place on the list, maybe last, but some place on the list "impact/cost or outlay" be still part of the discussion.

LOUIE: Let me just respond to that, which is -- because understand my bias. I'm an early stage venture guy, right? So my bias is the more money you give somebody, the higher the probability they will screw up. By constraining the resources you have to make tough decisions up front and making those tough decisions up front gets you a lot further down the path than if you do it the traditional way we do it in government, which is "Oh, you know, we've got unlimited resources. If it's under a billion dollars it's fair game." I think we just need to have our own mental discipline. Cash is just a good stand-in for that, you know, that constraint. Time is actually more important in some respects.

GOLDHAMMER: Okay. I'll take more comments here. We're going to do Ray and in the back.

STRONG: Okay. I think we already saw, a few of us, that partly from what Gilman said earlier, that persistence has an implication of sustainable cost. So it is there already, just hidden.

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GOLDHAMMER: Great. Next comment?

STRONG: Buried.

WONG: Sorry. I just wanted to clarify. So are we thinking about this in terms of a system as in a piece of technology or are we thinking about this as a system with people or as an organization?

GOLDHAMMER: The answer is yes to both.

WONG: Because some of those priorities there are specifically strong visualization tools, GUI, specifically pertain to technology.

GOLDHAMMER: That's right. And part of what we're asking you to do is to think about what elements of this system require technologies and technologies that may require strong visualization tools and GUIs; what parts of the system require human beings. And for example, the conversation we just finished, we ended talking about narrative and stakeholders. Those are not things that can be accomplished with GUIs and visualization tools. That requires people. So this system actually has both elements in it.

LOUIE: And you should not, when you're thinking about GUI, right, don't think of it as in being in Silicon Valley. You know, think of it as visualization tools could be a movie, right? So visualization tools, what I'm saying, and GUIs is a human interface. Could be a human to a human or a human to a computer or a computer to a computer. It might kind of free us up from our own natural biases here in the Valley, which is thinking oh, GUI immediately runs out at, it's some sort of, you know, next generation Windows OSX kind of environment I'm not interested in knowing. And I think GUI – it's in a very broad sense.

GOLDHAMMER: Go ahead, Ken.

PAYNE: I just wanted to ask how will we identify cost in a criteria if you lay it down there, if we want to identify it? And I'm looking at, you know, okay, if you think something's going to be like a trillion dollars, it's not going to work. But how do we do it on that criteria as we assess them?

LOUIE: I think from a developer's point of view the reason why you want to do it for as cheap, of as few resources of money, to get to whether or not you've got traction or not on the problem is to, not only to force our discipline but also reduce the probability of the "no".

SCHWARTZ: Of the "no"?

LOUIE: Yeah, which is, you know, in government there are professional GS14 Dr. Nos. Their job is to say "no", right? So the lower you can go below that radar where it's "Hey, you know, I'm just putting it on my kitty fund here," the higher the probability, you get to build your experiment.

GOLDHAMMER: Yeah. And I think just to clarify what I think I'm hearing is that not that we should we building – we should be thinking about these criteria and the system itself as being unconstrained by dollars. But rather, at this point in our process the, in this point in the exercise that we're working on together, whether we're at, you know, $100,000, a

Transcripts were not edited.

million dollars, five million dollars, like that is not actually going to be helpful for what we're trying to do at this particular moment. Okay?

PAYNE: I mean, don't start a new agency.

[Simultaneous comments]

GOLDHAMMER: We would've invited Congress if we wanted to start a new agency.

PAYNE: Just invite the lobbyists. [Laughter]

GOLDHAMMER: Yeah, the lobbyists.

TALMAGE: If I can do the breakout on that table, Peter and Paul, you're coming to this table, Darrell, Al and Mark Culpepper, you're going to that table over here. And that leaves who? You and Drew. You're coming to Gilman's table.

GOLDHAMMER: Great. So if you're receiving guests at your table, please make room. If you're emigrating from that table, please bring your chair. And then what I'll do is gather everyone back together in about an hour to report.

SCHWARTZ: Do we come back to this table?

TALMAGE: Yes, you will be going back. You just need to take a chair and your dots.

GOLDHAMMER: Feel free to start voting and allocating your five votes.

[TEAM ACTIVITY: DESIGNING A SCANNING SYSTEM]

During this session, three breakout groups were assigned. The groups each met with a different moderator and completed the activity described in the previous section as a means of discussing and forming team consensus on the prioritization of system design elements. The results of the exercise are detailed in the following section.

GOLDHAMMER: …And I know that I'm interrupting conversations at the other tables. I think we're at 11:45. We have about 15 minutes to report out. If your conversation was anything like our conversation, it's not going, it was not a kind of coherent, synthetic, easily reportable kind of conversation. And so with that as a preface, I'm wondering if we could start with, this is table number two here?

SCHWARTZ: No, table one.

GOLDHAMMER: Table one, could you give us a sense of the kind of conversation that you had? I'm not going to put the burden on you of summarizing the conversation but what kind of issues did you talk about, were there specific criteria that you focused on?

SCHWARTZ: All right. Well, we actually came up with a fairly clear consensus on a number of things. So we had a high degree of concentration on our voting. So there were a lot of things that

Transcripts were not edited.

we were in strong agreement on, that I would say. And then we added a few things, kind of novel ideas that I think were quite important. One of the important points we put up there is the importance of talent in the people and the quality of the people and it was very important, and the idea of how we communicate. And part of the incentive – one of the interesting ideas that came out was that if you try and provide direct incentives, i.e., money or things like that and maybe this insight -- Norm came up with the idea if everybody believed that their idea was going to show up in a movie script, for example, or even a short film or having a group of directors say, “We’re watching this to see what’s going to be in the next Spielberg film,” and so on, qualitatively different kind of incentive and so on. And so that kind of idea I think was a fairly powerful one. Is there anything else anybody would wish to add that I haven't said?

GENIK: Well we also thought that there should be a concentration on the narrative.

SCHWARTZ: Yeah, the narrative was very important.

GENIK: Plus the output and maybe use the output as an input. There could be some way to get that in there.

SCHWARTZ: So the real value, we used the example of the IED. It wasn't knowing about cell phones and RPGs and so on, it was the narrative of people assembling them into a new class of weapon.

GOLDHAMMER: Great.

BLOUNT: Are you going to tease out the differences?

GOLDHAMMER: Yes. Could you give us a sense of what your top three vote getters were?

SCHWARTZ: Oh, yeah. Openness was number one, persistence and incentives to participate and ease of use were in the next category.

GOLDHAMMER: Great.

BLOUNT: Nobody had reliable data. I think that’s also important.

SCHWARTZ: Yeah, we don’t care about reliable data.

GOLDHAMMER: We had no votes on reliable data.

SCHWARTZ: Yeah, we believe in, you know, just random information.

GOLDHAMMER: That was the narrative crowd over there. Facts don’t matter.

UNKNOWN: Facts get in the way of the...

[Simultaneous comments]

TALMAGE: The recorder can’t get this so let’s get the roar down.

Transcripts were not edited.

GENIK: Our consensus was that was going to be assumed to be part of the underlying technology of the system and we shouldn't spend a lot of time talking about it. But that has to be there.

GOLDHAMMER: Great. Would you start, Phil, just telling us what your top vote getters were, whether you had any zero vote getters?

NOLAN: I was going to say that although that table clearly listened in on some of the rich discussion of this table – [laughter] – they didn't have the craftiness to steal our votes, which are very, very different. Our top vote getters: anomaly detection, persistence and incentives to participate. There were no zeros but we had a whole lot of ones, such as openness, which apparently is a low vote getter. I'm worried, Peter. I normally look to you for guidance but on this --

UNKNOWN: Nine on that one.

NOLAN: So the discussion at this table in many ways ended up being, I think of as eminently pragmatic and it might be that Gilman here was helping guide us a little bit without even trying. Lots of discussion of what are the criteria that you need for Version 1.0, the version where you're just proving your concept. It doesn't really have to work that much better but it's proving your concept. And then when you get more money, more approval, more love from some senior manager of Congress, whoever it might be, then you go back with Version 2, Version 3.0 and you get some of these other criterion here. So that was one part of our discussion. Another one that I wanted to mention was a theme and it just kind of came in at 90 degrees but it was a good one. It was about some of these are static criteria – I think Steve, you brought this up – and a number of others were dynamic criteria. And mixing the two together can in fact – it may create some strengths but you actually may confuse yourself by saying are we creating a system which does one -- where we have the structure or are we actually creating a system where things flow through? So those were a couple big ideas. Anybody else want to throw out other things that they would -- remarkably interesting.

GILMAN: …wouldn't go that far, I don't think.

GOLDHAMMER: Phil, would you like to summarize our conversation as well? [General laughter]

NOLAN: …seem to be very good, at least on number two.

GOLDHAMMER: So in our group our top vote getter was persistence, second was bias mitigation, third was anomaly detection. Controlled vocabulary, which may give you an indication of the kind of group that we had, that got zero votes. And I would say that our conversation kind of clustered around our top vote getters in terms of the design criteria and I would say our conversation was fairly wide ranging within those criteria, sort of talking about both what those criteria meant and then talking about some of the implications of those criteria for actually designing a Version 1 of the system. A couple of key ideas that came up, one was talking about it's not about technology, it's about use. It's not about technology, it's about use. And so there was it seemed like a general consensus that what you're fundamentally interested in is the way in which technology gets used and adapted, not the actual invention of the technology itself. Another idea that came up at the end of our conversation was recognizing that given some of these criteria, and here I think we're taking criteria in a slightly different context, but some of them we understand – I'm sort

Transcripts were not edited.

of paraphrasing here – but some of them we understand and we know that they're hard to do and they take time, perhaps they take time, they take money, they take effort, but we basically know how to do them. They're just hard. Others of these criteria, perhaps like anomaly detection we don't know how to do so it's a different class of, in some ways a different class of criteria because solving for that criteria would require a different kind of solution than the things we actually know about. Let me stop there and ask if the table would like to add anything that I undoubtedly forgot.

BLOUNT: I think the only other thing I'd add is just the notion that a lot of the conversation initially steered towards this being for harm prevention rather than opportunity upside.

GOLDHAMMER: Great. Yeah, so we did have a conversation about sort of how to think about what the system is ultimately trying to identify, whether it's about harm, whether it's about opportunity. A little bit of discussion about what we meant by harm, harm to who, how much harm. Any other comments?

So we have just a few minutes before lunch. I think now that we've had, at these different tables, conversations about these criteria, I want to try to get – just insert a little bit of kind of practicality right before lunch to sort of orient our brains to what we're going to be doing after lunch. So you'll remember from our agenda this morning, after lunch we're actually going to be in the teams that you're in now clustered around these very long tables with a lot of material that you'll be able to use to actually create a process for this V.1 product. Now we've heard a lot about sort of the basic criteria for this V.1 product. It's not going to cost a trillion dollars, you're not going to spend five years building it, it has to meet some of your key criteria here as well as some of the issues that – some of the thoughts that Gilman shared earlier this morning. You want it to be able – It's a proof of concept, it's a pilot. You want to be able to demonstrate to your venture capitalist that you can make this idea work not on a shoestring but in a relatively short amount of time with a relatively limited amount of funds. And so what we need to do now is start translating some of these more general ideas around criteria and design challenges into the specific ways in which we're going to move from this conceptual model to an actual system. And so let me just kind of, just to get ourselves thinking about this in the back of our brains over lunch, does anyone want to just take a first salvo or first shot at either ways to apply some of the criteria that we've talked about to actually designing the system, where you think you might want to start? Just any thoughts about –

SCHWARTZ: I have a question.

GOLDHAMMER: Yes?

SCHWARTZ: And it goes back in part to Gilman and to our sponsor. This notion of Version 1.0 versus the system you would like to build. My question is this: In thinking about Version 1.0, do you think of this as just simply a more modest version of what is likely to be built in a sense subsequently once you've proven it out or is this really just, you know, okay, we're going to try a proof of concept and then you have to redesign to really build something more substantial. How do you think about this? Because the truth is I think if we target just the pilot system, I'm not sure we're getting full value out of the group. And if, on the other hand, we target an ultimate system, we may not have something we can build to get started. So the question, how do you get that balance right?

GOLDHAMMER: Gilman, do you want to address that before we take other comments?

Transcripts were not edited.

LOUIE: So, I mean, it's a good point and is an argument, should we being doing 1.0 or 3.0. So let me just kind of get people on a common vocabulary.

[Simultaneous comments]

SCHWARTZ: That's what I'm aiming for. Thank you.

LOUIE: First of all, difference between -- first of all, software design in my view is nothing ever really works as the way they're supposed to until the third version comes out, right? And Version 3.0 usually is after Version 2, which is kind of an add-on to 1 and patching any new features. You throw everything away and you rewrite to get Version 3, incorporating the concepts but maybe not the exact code base and process base that you – just kind of understand it as a ranking. What's really important in 1.0 is what are the things that you have to do not only to produce a result but produce a result that distinguishes you differently and makes you special versus the old system and the older version. If you can't demonstrate uniqueness of value or application or way of thinking about the problem with 1.0, you'll never get to the 3.0. So it's not just good enough to come up with a system that gives you a forecast if what you get is not that different than what all other forecasts gives you. On the other hand, it doesn't necessarily need to be that robust, be that reliable, built to last or any of those things. But what are the minimum things you need to say there's something really, really special here. We should continue to pull on that thread.

GOLDHAMMER: Darrell, do you have something?

LONG: So I'm going to deliberately be a bit provocative here and Gilman will be able to chime in on this. We already have 1.0 of this, right? It's called the intelligence community on Sand Hill Road, right? And so what are we trying -- what I think we're trying to do is we're trying to get beyond what we have now, right? And so, you know, that's what -- what I want to understand is, you know, we've got who knows how many analysts in DIA and CIA and in the State Department whose job it is to do most of these things on the list, right? And then we've got Sand Hill Road, right, who's also doing some of these things on the list but for a different motivation. So how do we get beyond that from the existing system that we have?

GOLDHAMMER: Good question. Jennie?

HWANG: You are particularly kind to Bill Gates, you know, who's on the conversion cell block -- Windows. But I think another way to look at this with the final outcome is there's a lot of, most things are done in such a way, including the documents and reports, you really want to have a maximum angle with the picture, you know, 360 degrees rather than 200 degrees at the beginning, then you come down with some of the constraints and availability and quality of information or even people so you turn out to be perhaps less than that. That's one thing. The other is, you know, instead of looking at the basement of the walls of the Federal Reserve, we should really look at, you know, reach for the sky. So therefore then you come out with the best things. With that kind of goal, it seems a lot of things work out that way. Even if you have that, you're not able to reach that. But you could say the limit there, then chances are you're able to reach, you know, an outcome with even less than what you set out for. So that is another perspective, you know, to see how you really look at things.

Transcripts were not edited.

GOLDHAMMER: Great. Harry?

BLOUNT: I want to pop back to Darrell's point a second because I think if we are looking at this as persistent and trying to get from the 1.0 version of what we already have out in the real world, one of the biggest challenges in the intelligence community, venture capital community, is the idea that you have a systematic feedback loop that can be captured and monitored. And I'm not sure that if we don't walk out of here with at least some conceptualization of what a feedback loop is and how to measure it on a persistent basis to really improve the system on an ongoing basis, I think that will be a huge missed opportunity.

GOLDHAMMER: Okay. Stewart?

BRAND: We've got a couple biologists at this table. I think of these things as larval and adult form and taking Darrell's approach you can say the intelligence community and venture capital community is sort of the larval form of what? And what we're trying to think about is what's the metamorphosis that would take it to this next stage so it can fly around and be beautiful and so on, or you can say 1.0 has got to be the larval, which means it has to feed itself and metabolize and have the capability of being something even more interesting later. So those are two approaches to take. Are we doing, creating a larva from an egg or are we metamorphosizing what already exists in something else? Probably two different techniques, both interesting.

GOLDHAMMER: I think one other point to add is I don't think the goal here is to reinvent the wheel and to the extent that there are, you know, there are in the world, in the intelligence community or in the VC community, there are elements of the system that can be a source for that system. That seems like something you want to think about and incorporate at either some practical or some kind of computational way into the system that you ultimately develop. You don't have to reinvent it from scratch. You can assume that it exists.

WINARSKY: So another differentiation from the 1.0, I mean, you've very clearly articulated two communities that develop these type of forecasts and that the venture community and intelligence community. One of the important points this table had was openness, so we want forecasts from everybody. We want crowd-sourced forecasts. We want forecasts from somebody in a tribe in Afghanistan. So that would be very different than the two communities that we talked about.

GOLDHAMMER: Okay. Other comments? Yes, Stan?

VONOG: So it's been very interesting for me to hear and kind of understand now what we're trying to design. So I heard these problems like you have report one, it was one report and interesting. Build system ten times, same results. And then, so some of the things here isn't native with me, actually, and one of the things it was -- I went to Walt Disney Family Museum, which was just opened in the Presidio. And, you know, when you were talking about movie stuff, so that's one of the things -- So I saw one thing in the Walt Disney Family Museum which was amazing, and it amazed me so much that I and my colleagues are trying to build our company a similar way. It was a Walt Disney org chart. And it was not like a tree chart or something, like the whole process, it was like a whole circle and in the upper side there was a story which comes from Walt Disney and then it goes to the middle and then on the one edge of a circle is like animators and on the other edge technology innovators which are building all these moving cameras and all those special effects things. So I was thinking like – I had this idea, and I see that many people have this idea too, so it may be like a radical idea for the system. Maybe you could just separate like Walt Disney, producing -- like Walt Disney produces movies. So you could produce like reports or something and story comes straight to the center. And on one side is all these data analytical tools, like all this crowd sourcing, social networks, data filtering, whatever, so it's not based on like reality. But on the other side is scientists and experts who kind of validate this story thing. So this crazy, you know, movie writer invents a story based on doomsday scenario or opportunity scenario and then you kind of get data on one side and then validate scientists, so they say, "Oh, it's not going to happen in five years or it's not going to happen in three years." And you have like many, many story writers. You a have Russian story writer who writes their own story, like U.S. story writer, and you, just your product is like movies or whatever, like mockups. So all very --

GOLDHAMMER: Good. Interesting idea. Very good. I just want to take an opportunity, for anyone who has not spoken yet today, I want to give you an opportunity, if you have any thoughts you'd like to share with the group at this point.

NOLAN: 100% participation is pretty good.

[Simultaneous comments] [Laughter]

GOLDHAMMER: Yeah, I'm not a cold call caller. I'll open up the opportunity space but I'm not a cold caller. All right. So I don't think we've reached consensus on exactly what it is that we're trying to develop in the afternoon. I think the one thing that I want to leave you with though before we head to lunch is we need to be practical and pragmatic. We need to come out -- for those of you who've written books, you probably had the same experience I did, which is that when you finished the book you realized what it is you actually wanted to write. [General laughter] [Simultaneous comments] Exactly. And so I think, I would expect, I'm just going to signal now that that's probably the way you're going to feel sometime around four o'clock this afternoon, which is that by the time you get to the end of this process you'll realize exactly what you wanted to do. But I think fundamentally what we're trying to do using spatial relationships and causal arrows is to develop an outline of a V.1 system that may borrow from things that already exist in the world, that may combine them in new or novel ways, I think as Stan was describing, borrowing, riffing off of Walt Disney. And I would suggest that after lunch -- So we'll break 'til one o'clock. After lunch let me suggest that we all come back to our groups, that we spend about ten minutes just kind of getting some alignment within the group around what exactly is this product producing. Let's get sort of a storyboard image of what the result is supposed to be, some alignment around the key criteria that you're going to optimize for. And then when you're done with that conversation, group number one, you're going to be at this table over here. Group number two, you're going to be at the table back here and we're group number three and we're going to be at the table over there, all right?

BLOUNT: Hidden away.

GOLDHAMMER: Hidden away in the corner. Any questions about what we're doing now and what we're doing after lunch? Daniel?

Transcripts were not edited.

TALMAGE: I have instructions. So for our accounting department, we need you guys to sign in. So there's the sign-in sheets over here. There's a guest, a guest sheet and a committee one. Once you've signed in you can loop on around and lunch is served. [General laughter]

SCHWARTZ: No lunch 'til you sign.

Lunch Break

INTRODUCTION TO TEAM ACTIVITY: DESIGNING A SCANNING SYSTEM

GOLDHAMMER: Why don't we get started. Have a seat, please. Finish your conversations. iPhones in pockets.

TALMAGE: [Laughter] Jesse's good. He spotted the phone.

GOLDHAMMER: The thing I love about these kinds of meetings, especially when you're bringing the outside guests in and you want the alternative perspectives, is anyone -- how many Apple devices are there in this room? [hands raised] How many Windows based devices are in this room? Or Microsoft OS devices? [hands raised]

[Simultaneous conversation]

GOLDHAMMER: Okay, can I get your attention? So we're going to dive back in. I'm sure that over your Cobb salad you had time to reflect on the 45 different elements of this system we're going to be building this afternoon. That's great, it's wonderful, I'm glad it's top of mind. I want to give you -- as you probably have noticed, and it's quite intentional, that we've been moving from high concept in the morning and increasingly more and more granular. And now I want to take you even one step further. So the first activity we're going to be doing in our teams is designing a scanning system and I want to give you an idea – and this is literally just an idea of what that might look like and sort of, and just kind of hitting a level of kind of granularity that I think is appropriate for this kind of exercise. So if you have still in front of you this conceptual map, you'll see that one part of it is people feeds, all right? So at some point the committee said you know what, people feeds is a really important input into this system. Now that may be the wrong term to describe it. There may be other things you'd want to add to people feeds that are not there. There may be text in that page that is the wrong text. All that being said, if you were to actually build that out and say how does this actually look, you could do something like this. So you could imagine having as one of your process elements some kind of DOD analytic unit, which is coming up with strategic questions. Questions around disruptive technologies, questions that they want to put to people elsewhere in the world, questions that are driving research, questions that may be driving hypotheses that may get answered with data later on. But some group of people has to figure out what are the questions we're asking here, all right? So there's some kind of analytic unit. That analytic unit might be driving survey research and you might be doing twelve global surveys with incentivized participation from experts. You might want to be doing surveys on a global basis and not just in a local basis. You are building a V.1 system. You're not doing a thousand surveys. You're doing something that's manageable. And those surveys, that survey content is bring driven by those strategic questions. You might also do a prediction market and there's a relationship between the two. The survey data is telling you what's going on now; the prediction markets are telling you what's going to happen in the future. Some of the questions that you might be asking with the survey data may actually end up helping you to determine whether these predictions, depending upon how far out they are, are actually the right predictions. And this is something, for example, that Monitor 360 is doing now in Pakistan and Afghanistan, which is that we're using Gallup, who's doing polling in places like Afghanistan, asking people on the ground questions about what's going on, we're running a prediction market and we're using those polls as data that will help us to determine whether predictions about whether there'll be a certain level of support for the U.S. military at some point in the future is actually right. Right? So you can imagine a relationship between these two things, and those are both again people feeds. And then that feeds into five global synthesis workshops. So you've got a bunch of data that you're collecting and survey data, prediction market data, and then you have to figure out what it means. And you want to figure it out using a bunch of diverse outside perspectives. You want people from different, speaking different languages, different customs, different use, use technology in different ways, and you can do it in five different places. So again, this is purely hypothetical. This is just a stake in the ground. It's just an effort to show you that if you were to take this little conceptual piece from that process model and build it out and show the relationships and then show feedback, that there's iteration here, that it could look something like this. And this might be one piece of what you end up having on your boards. At a conceptual level, are there any questions about this, as a goal? Wow, really? Good. So here's, again, a good example about how -- I was expecting something.

SAFFO: I'm just kind of stuck on the part of the local survey of Pakistan, but…

GOLDHAMMER: So there are five people that you're asking Pakistan the questions and then they, you just re-circulate those questions with those five people and that's what you need. [General laughter] And they're all in a café.

NOLAN: Only five that matter in Pakistan. [Laughter]

GOLDHAMMER: That's right.

NOLAN: Which five, is the question.

GOLDHAMMER: So here's what we're going to be doing. In your team you're going to be developing a process diagram that illustrates the essential steps in your scanning system and meets your design criteria. And remember, each team came up with a set of design criteria. Spend the first ten minutes in your teams at your tables discussing how – put a stake in the ground on how are we going to do this. Are we going to start with the output, are we going to start with the collection system? What is the process that you as a team are going to use to try to elaborate on this process diagram? And then in the remaining time that you have – and I'm going to give you about an hour and a half total – you're going to start to lay down the process using the materials that we've provided. Teresa, are you here? Let me give you an example of what these materials look like. So we have pre-cutout shapes, all right? This is very tactile. So you have different shapes. You can assign a meaning to these shapes if you want to. They don't come prepackaged. The triangle doesn't mean anything but you can decide that it means something in your teams. We have pens, we have of course the re-stickable glue stick which allows you to put your shape onto the table and have it not move because someone pushes the table and it slides over. We also have pushpins and these are your causal arrows right here. You have to be able to show how one thing connects to the other things. There are inputs and outputs in a system. So you can use this as a way of showing how, for example, if we went back here, how the [*coughing*] analytic unit was driving survey research, which was driving prediction markets back and forth iteratively and then down to a global synthesis workshop. So we want you to show us what are the elements of your system and we want you to show us how they're connected, not necessarily causally but in a process sense. Does that make sense?

UNKNOWN: Yes.

TALMAGE: Now can I put in another word? For this event we're actually going to record each table. We're going to have somebody transcribing so if you could say your name every so often as you start to say something, it will help them to keep track of that. Because we have some of our staff doing the tracking today.

GOLDHAMMER: Can we just meta tag everyone? Is that possible?

TALMAGE: It'd be nice but we can't do it.

[Simultaneous comments]

GOLDHAMMER: So now are there any questions about what we're going to be doing for the next hour and a half? Any questions first before I give you the next set of instructions?

SCHWARTZ: Yeah. We are not trying to produce convergent results, I assume. Is that correct?

GOLDHAMMER: In fact, it is precisely the opposite. We are hoping for divergent results. So each team will be producing their own process map. At the end of the hour and a half we're going to ask each team to give a short report out, just walking us through what you've created in that 90 minutes, and it's just a little bit of a kind of pressure test report out where other parts of the group, committee or guest can say, "Well explain to me the connection between this and this. Why did prediction markets then lead to having people who use crystal balls and then why did the crystal balls lead to, you know, briefing Admiral Mullin, and I don't understand that connection." So we just, just a little bit of a pressure test. And then remember the final activity, which we'll come to later, will be to layer in another level of detail in your process map looking at how do you actually do it. Does it require ten people, fifteen people, twenty people? Are these partnerships, are these inside the government, outside the government, what kind of technologies do you need? All those questions as well. Peter?

SCHWARTZ: Another question. When you say scanning system, is this going all the way from top to bottom of this chart or only part of the way down this?

GOLDHAMMER: I believe -- I'll actually maybe let Gilman answer that question.

LOUIE: So if you take that as a linear chart and assume that it was originally a circle, just kind of turned back on the straight, natural feedback loop, is can you design a complete loop, one iteration of the loop.

Transcripts were not edited.

SCHWARTZ: But involves all these elements, is the question. That's the question.

LOUIE: If you believe those are the right elements. I don't want to bound it by –

SCHWARTZ: But it could.

LOUIE: It could but it could be a bunch of other stuff or different stuff that's in there.

SCHWARTZ: But we're not limited to, your example, like people feed, it is the whole story here.

LOUIE: No, that's correct. It should drive it through the cycle.

SCHWARTZ: Through the full cycle.

LOUIE: Right.

SCHWARTZ: Thank you.

GOLDHAMMER: Now there are a lot of ways to skin this cat. I imagine that every team is going to do something a little bit different. What I would encourage everyone to do is to be as engaged as, to sort of as engaged as possible in sort of what the team is focused on. 'Cause I think the risk with an exercise like this is there are going to be two people over here who are saying, "Oh, what if we did it this way?" and then two people over here saying, "What if we do it this way?" Having the conversation as a team I think will be the most, you'll get the most effective results at the end.

WINARSKY: Are we designing in this stage the system as we imagine it complete or are we designing the alpha version that might be implemented in a short period of time and energy?

GOLDHAMMER: Gilman?

LOUIE: I think, let me give you the kind of, in the perfect world but I will leave flexibility up in the teams. You might have what I would call – let's say that this bar or this unraveled loop is called "stack," right? So in the stack are the things that you think are all the important parts in the stack and then put an actual bold box around the things you want to be in 1.0, right, which means these are the things that we have to do and then put maybe a brighter colored box around the stuff that we, what we want to do really, really well, and we just assume all of the rest of the stuff will, you know, marginally do 1.0 just to get the stack or not do at all, right. So I want to know what you think is a requirement for 1.0 and what you think is going to be the spectacular jump out things that you put a lot of resources and energy behind. But it's okay to include all the other pieces that's in there so at least we understand conceptually where you're driving to.

SCHWARTZ: So for example, going back to Jesse's diagram – for example you might say we cannot possibly do without a minimum of 12 global surveys. That's got to be part of the, even a system 1.0. And the final one might have 25 but we've got to have at least 12 in Version 1.0.

LOUIE: That's right. And that's a great example.

Transcripts were not edited.

GOLDHAMMER: These are designed so you can write on them. This paper you can write on. And we've given you a lot of space because we're assuming that we, we want to get as much detail as possible. And when we're done we'll be taking pictures of these, sort of sequential pictures, so this will all be captured.

TALMAGE: And it'll be captured on the tapes.

GOLDHAMMER: So Daniel before the exercise that we finished right before lunch had sort of assigned this table to the other tables. Keep those assignments. You go back to the table you were with before lunch. Questions?

WINARSKY: Can we have a round table? [General laughter]

TALMAGE: You can use – I'm sure there's some design innovation you guys could use to take the rectangular table and make it round.

GOLDHAMMER: All right, any other questions before I let you loose?

GOLDHAMMER: All right. So again, my recommendation is in your teams have a ten to fifteen minute conversation first just to figure out what you're going to do and then go do it. Okay?

UNKNOWN: Can we have our recruits back?

GOLDHAMMER: Yeah.

[TEAM ACTIVITY: DESIGNING A SCANNING SYSTEM]
1:00 P.M. – 2:30 P.M. (SEE APPENDIX E)

SCANNING SYSTEM GROUP BRIEFINGS
2:30 P.M. – 3:15 P.M.

Group 3 Briefing (Option 1)

GOLDHAMMER: OK., why doesn't everyone gather around this table please. So having walked around the room my self it is clear that each team approached this problem in very different ways. This team, you can kind of take a look and sort of read what is on the different post its. Darrell is going to kind of walk us through at a high level and other team mates and team members who want to add in or expand, please do so. Let take just about 5 minutes to explain. If you have any questions, that the rest of the group may have, we can talk about it.

LONG: So you shouldn't think about this literally, but we'll do it literally anyway. So up here we have stakeholders. These are the spheres of interest that whoever the client is, what their interested in. From this one thing we'll come out with is big picture questions. And one way to think of this is forcing functions. If you are interested n climate, for example, would be a forcing function. Then you have data collections, this is passive data collections, constant persistent bringing in all the data, and whatever the data here is, publications, grants, financials, whatever. Here we have active (?). Maybe actually, not just actively looking for things but probing the system and looking for reaction in the system to see how the system responds. Here these are creative people, these are hypothesis generators, think of these as science fiction writer types, people that dream happy dreams, and have nightmares. (Laughter) but not necessarily are constrained. The importance here is that these people are not constrained. These are not people that are tied into policymakers or stakeholders, these are guys whose job is to dream of stuff. This is going to generate a set of hypotheses. Here we evaluated hypotheses. A very nice dream, however, that violates clausality, that can't happen, and that feeds back up here. That's going to feed back into both the collections process, because this is a very interesting hypotheses that you have. This could be a threat, or this could be a opportunity. We need to know more about it so we will increase collection in those cases. Or it can be that was a really good hypothesis but need to refine it, or it could be a bad hypotheses and it can't happen. So the evaluation process may be There is a broad spectrum of evaluation of what happens here. There are scientific experts, which we are biased towards them. But there are financial issues as is practical to new financially, social, political, all this stuff, and then there is the gaming industry and this sort of clouding everyman coming in. So this is going to evaluate the hypotheses, and that is going to produce a raw output. Whether this is a good hypotheses… let's back up here to these guys.

GOLDHAMMER: Those guys are?

LONG: These are the hypotheses generators.

GOLDHAMMER: : Back to the hypotheses generators?

LONG: Back to the hypotheses generators. Now down here,

GOLDHAMMER: Just before you get to things down here, things that come in here are new questions. Did we miss something? Ranking analysis. These guys come together, and within their area of expertise or in their area of, or not necessarily their area of expertise, come up with "are we right" , are we on base, are we off base, and then scoring, and then that then feeds down to.

LONG: Right, right. This is sort of raw, goes back up to the hypotheses generators, this goes down to the storytellers, and take all this stuff that we have heard of a couple of times and remove the decimal points. This goes out to policymakers, things like this. This feeds back to (we need a line here guys, feeds back here, put a staple in this)

GOLDHAMMER: They're are the policymakers, is that right?

LONG: No, these are like an agency kind of thing, right? Down here, this is the president of congress.

GOLDHAMMER: : So who are these guys?

LONG: Some agency that is charged with doing some kind of forecast (simultaneously speaking with members of audience), maybe we need three dimensions here.

GOLDHAMMER: Questions? Questions?

Transcripts were not edited.

SCHWARTZ: How many people do you need?

LONG: How many can you afford? This is a scalable parallel architecture. (simultaneous audience talking), you've got collectors, already in the system. So you're going to leverage existing collections, so here's all collections. How many people is that, I don't know. How many hypotheses generators? Probably a fairly small number.

SCHWARTZ: What a dozen, half a dozen?

LONG: Yea, not hundreds.

GOLDHAMMER: Where would you put in the country factors? In other words, I've got eased into the traditional … hypotheses engine should have your regional panelists, that part of the engine which would increase the rate.

LONG: I don't want analyst there, I want analysts down here.

UNKNOWN: And actually Perry and I were talking about this, this gaming, cloud sourcing, this step we have our subject matter experts here but then here we bring in that cross leverage.

LONG: Here is where you do the impact analysis. These are the guys that are informed by the big question. These guys say "we really need for you to pay attention to Middle East now". And these guys will make hypotheses appropriately for that, but analysts in the traditional sense that you and I would talk about analysts, their not here. They are not creative, but panelists.

GOLDHAMMER: I have a question. Are you able to forecast a disruption?

LONG: You're asking me to forecast,

GOLDHAMMER: For this very systematic model.

LONG: We think so, that is why it is designed this way. These guys here, we want to be ahead of the curve, if we didn't have these guys here and just analyzing data, then we can only pick up things that have either happened or very close to happening. What we want here is for people to say, I'm seeing signs of things, and they go huh, maybe if just a couple more things happened, I could do this crazy thing. These are the guys that are trying to project us way out on the curve.

SCHWARTZ: But you connect these guys this way, they feedback.

LONG: They are getting feedback. These guys are getting information, this is the state of the world. We were just suddenly able to increase communication by a factor of 100. Oh, okay, that does something.

SPKR: That's scary.

GOLDHAMMER: How do you get the feedback to get the right type of people?

Transcripts were not edited.

LONG: There are actually two components to this feature. Part of the narrative engine is creating a plausible human condition scenario that is somewhat tied to that hypothesis. So there is a feedback loop, there is one through here and one through here, right? If people are being evaluated on their performance, right, these guys are consistently generating crackpot things, antigravity weapon, you get a different job.

LONG: If you think about Proctor and Gamble, everybody that go to Proctor and Gamble to work start out in sales. No matter where they end up they are all required to start in sales. Imagine an analyst structure where everybody is their first job has to go on walkabout, so that they are going out to odd spots chasing up things generated out of this. So everybody spends some time way out in the field before they come back. Some kind of glossed over quantitative person. Coming in, coming through here we have a ranking system, we did bring that down, and when we called in the ranking, unlike [mike noise] they consent to see the consensus, we want to see the outliers, and then this feeds back up so we find out which group was more accurate. The consensus or the outliers based on the hypotheses.

GOLDHAMMER: The two big drivers of the consensus, this is really great. But this real critical, what is in here is really critical to your system.

LONG: How it is really used, that is the newest.

GOLDHAMMER: How does this system improve over time? Is there a group of people that get smarter?

LONG: Hopefully everybody gets smarter. If you just rotate people back and forth. You'll find some people are good at some things, some people are very good at evaluation, people that are good at check arithmetic and not good at creating things. You are not going to recycle those people. But some people you are going to recycle through.

UNKNOWN: My biggest concern [mike noise] that wrote the Black Swan, his book is about [mike noise] do Black Swans occur. And they may not occur in days, months, and some years, how do you evaluate someone?

UNKNOWN: Rovini was wrong, wrong, wrong!

LONG: So let me just close our conversation on this one, and put the team over there on the hot seat

GOLDHAMMER: This was great, thank you. Okay, gather around this table!

Group 2 Briefing (Option 2)

[Short beginning of brief not recorded]

REED: So and then we also use kind of classic techniques such as brainstorming, market surveys, mobile, collection with like mobile phones, data collection. We can look at games, tweets, you know, what's going on in the news, current articles, and we can extract predictions a little bit more that we'll get to in just a second. Let's see. What is this one? Oh, yeah, so once we start, especially when we start identifying communities, we really want to identify communities that are doing something, that have resources behind it.

Transcripts were not edited.

Either a lot of people are working on it or they have funding or there's some sort of resource that makes that community interesting. We have the -- can't remember how to use this.

LOUIE: That's the comparative engine. That's the --

REED: The comparative engine. Thank you.

LOUIE: Fundamentally that engine's supposed to look at, you know, a survey of lots of different media than that and find out what's new happening.

UNKNOWN: Right. Is that a computer or is that a person?

REED: That's automated. It's a computer. But we have this cool legend here. If you look at the A's those are automated by computers. "A" just means there's a human involved.

McCORMICK: S's. "S" means semi-automated.

REED: Yes. Okay. As well as "A-H" also means something.

SCHWARTZ: And "S-H" is semi-human? Is that…?

REED: Yeah. [General laughter]

[Simultaneous comments]

REED: And so we get, we do involve, this involves some excerpts here, right? Then we get narratives from -- Is that right, Jennie?

TALMAGE: Jennie's in the back here.

HWANG: Oh, yes. [General laughter]

REED: And the multi-narratives, where do the narratives come from? Do those come from the experts?

MARK: They might be regenerated by narrative generators.

LOUIE: Yeah. So they could be regional experts or technical, right?

REED: Right, right. But those are...

[Simultaneous comments]

HWANG: The narrative, you know, to be really valuable, has to come from integrators in the real world, rather than one type of expert.

SCHWARTZ: Well, you know, you can actually, and it has been done – I mean, some of the movie studios have done it – you can actually create a narrative computer engine that basically combines -- You know, every movie is either a comedy, an adventure or a love story, a mystery, that's it. You know, you just combine all the variations and that's it. And they all have 3X.

GOLDHAMMER: So since we've got another one to go, I want to pick up the speed on this one and kind of hit a whole bunch of ideas as fast as we can. So Ben, just go, go, go.

REED: Okay, okay. So up to here we just have, we're collecting ideas, so we're going to have a bunch of ideas. And then the idea here is to filter them out, to extract conditions for a prediction. So basically we have a bunch of predictions. We start extracting conditions for the predictions, we start extracting conditions for the predictions, we start correlating them with current events that are happening in the news, right, so this could be automated. And then once we have these predictions then we start the humans, looking at them, mapping it to current trends, current models. Then we start doing things like backcasting, second order analysis, and then -- I wasn't involved in this at all down here. [Chuckles]

[Simultaneous comments]

GOLDHAMMER: Gilman, why don't you tell us about it.

LOUIE: Yeah, one thing to note here is that there are specific models of technical evolution that we see that should be mapped against what we're seeing on the signals and idea creation and then actually use both human and automated systems and do that computation. Then, once you're going to get that data, really begin to extract out both the signals and signposts. And this is the potential future. Can you backcast and create the signposts as well as look at what's out there and match what is out there signaling that's matching up against those signposts. And then report in a way that is useful, whether it be, you know, dashboards and maps and lots of diagrams that people can understand, kind of what is the potential possibilities, or even doing things like storytelling, kind of a day in the life of the future. It could be in the context of a game, it could be in the context of a movie, a short, a piece of fiction, but to be able to tell the story in the context of somebody's everyday life from their point of view based on where they live in the world and how technology's going to affect them and then feed it back then to create new ideas.

TWOHEY: So it's just disruptive technology then?

LOUIE: They're very focused on disruptive tech.

GOLDHAMMER: Any other questions, one or two questions?

UNKNOWN: That was just brilliant.

MARK: You left out the prediction markets.

LOUIE: Oh, yes, and that we can also use prediction markets in a different way, yes. So the problem with prediction markets as we learned in the committee is that it's really bad for long term forecasting because you make a prediction and you don't know if you'll collect any money 15 years from now. So the idea is don't use prediction markets to predict the predictions but use it to predict the signposts. When do you think a signpost is going to hit, what's the probability of the signpost becoming real and use that to evaluate signpost analysis.

SCHWARTZ: And how does this -- how does the system get smarter?

LOUIE: That's one of the ways. So as you begin to look as the signposts are either not being hit or being hit, you may say you know what, we need more work or resolution on the signposts because you're not matching. You may be having problems in the natural collection of the signals.

SCHWARTZ: But who's making that statement? Who's the "we" in that case? We --

REED: This is a continuous flow. This isn't something that stops.

SCHWARTZ: Right. But who's the "we"? Is there a committee, is there a group?

LOUIE: Yeah, there's a team. There's a group, there's a team running the system so they're the --

SCHWARTZ: And they're the ones getting smarter.

LOUIE: Hopefully.

REED: But also, since we're collecting predictions from the crowd, like media, and –

SCHWARTZ: And do they get smarter somehow?

REED: Yeah.

SCHWARTZ: When we give feedback?

REED: Yes.

LOUIE: So there's this concept of getting smarter versus having better maps and more maps. So the concept is and where it's really important for us is not to filter too early. So try even the bad ideas but map it, right? The more maps you have, you know, more good and bad ideas where you begin to track things as they become real, it will enlighten you hopefully or users of what is more likely to happen in the future versus less likely.

SCHWARTZ: Are these what you mean by maps?

LOUIE: Part of this is the analysis of the maps but it's also in the backcast they're here in the signpost generation.

REED: There's a map there with signposts and visions. The axes are the impact of uncertainty.

SCHWARTZ: So in this model it's more is better and don't filter too early.

GOLDHAMMER: Let's see how the third team did.

GOLDHAMMER: Let's take a look at the last table, please.

[General Conversation]

Transcripts were not edited.

GOLDHAMMER: Okay, last report out. We’ll do a few questions and then we’re going to go to a break.

GROUP 1 BRIEFING (option 3)

GOLDHAMMER: Okay, last report out. We'll do a few questions and then we're going to go to a break.

SCHWARTZ: So this is organized mainly in three groups. This is mostly input, analytical approaches and things that we're doing with the stuff, and then the outputs. So we have many different sources of input. You can see all the variety here, blogs, forecasters, journalists, people – Oh, yeah, this is an important point, people on the ground all over the world – Aid workers, NGOs, soldiers, etc., the people who are actually seeing things out there. So there’s a whole bunch of sources of input. A variety of ways to analyze. We also came up with a number of incentives. For example, the idea of movie scripts, reputation enhancement, the idea that there will be interesting people listening to them. So that’s another incentive. Crowd sourced analysis. Each of these represents different approaches to analysis. Now back upstream here – and this all goes back to the feedback – are the various forms of output. Part of it is actually specific queries. So a policymaker says, “I want to know is cheap launch on the horizon for space vehicles?” A typical query. Systematic reports regularly – quarterly, annual, whatever it is. The analyst in the system who’s a member of the Committee on --

WINARSKY: To assess disruptive technologies.

SCHWARTZ: Yeah, the Committee to Assess says, “You know, we've been looking at something, something interesting is coming along. Policymaker, you need to know about this.” So it’s driven by the analyst. Then finally the Disruptipedia. The Disruptipedia is the public face of this where all this information gets both displayed and people can input and participate. So part of the incentive is they get to see their stuff on the Disruptipedia and the Disruptipedia is part of the interface that they get to interact with. That, in turn, feeds back down here, improving the questions – that’s one of the ways it gets – and also crowd sourced analysis off the Disruptipedia. Team, have I missed anything important?

GOLDHAMMER: That’s great.

GENIK: I would just add that all of our inputs here are inputs to all of the decisions so that we didn't draw every little line. It’s like an application programming interface (API), everything can feed in and everybody can draw from back here and this system will generate output without any inquiry to it.

TWOHEY: The other thing that we didn't really say here is that there's the fundamental philosophy that it’s okay to try a bunch of different things and have a bunch of predictions that just failed utterly. Because the whole point is that it’s going to be disruptive, most of the time it’s going to be wrong. So I think in a lot of other places there was no inherent tolerance for failure and that was one of like the key design criteria that we had is that you're going to have these creative people that were going to feed stuff in and if most of them were wrong most of the time our system still had to work because that’s actually how most people are when they look at the future.

Transcripts were not edited.

GENIK: I guess the last thing I would add here is that there's – we have sort of one system designed here but we were thinking along the lines of several different systems that would possibly be aggregated, there would be an aggregation step as well and then it wouldn't all be done by the same groups in the same…

GOLDHAMMER: Questions or comment? Yes, Stewart.

BRAND: I think the output array here is really dead on and as a participant in the first table over there I would replace our output array or add to it this stuff but keep the hypothesis engine and analysis that we have over there.

SAFFO: With our front end and your back end, Peter –

[laughter]

SCHWARTZ: I've sort of always thought of us that way, Paul.

[laughter]

BLOUNT: Paul, you get the line of the day.

[laughter]

HWANG: Well, the input from graduate students, would you think that would be based on the job market?

TWOHEY: The idea we were thinking of is that – So a lot of disruptive technology innovation comes from U.S. funded research for graduate students at our universities. And so if you had every student, every semester as a contingent on their funding write three paragraphs. One that was what do they think the coolest thing that's happening in their very specific area, in their field; what do they think the coolest thing that's happening in their field, like computer science overall; and then what do you think the coolest thing that's happening just in engineering. What's going to change the world? So if you get – there's this whole thing about experts versus crowds, right? Well, how do you make an expert? Today's graduate students are probably going to be tomorrow's experts in these things so you can get them younger, fresher, less jaded and you get this --

SAFFO: There's only one qualification to this, speaking as someone who has a Ph.D. student who's four years late on his paper, getting engineering students to write three paragraphs often takes an entire quarter. [laughter]

TWOHEY: It's a contingency of their money. They don't get that –

[Simultaneous comments]

SCHWARTZ: A requirement of the grant.

GOLDHAMMER: We were talking about incentive systems, right?

[Simultaneous comments]

TWOHEY: And that was actually the thing that we thought was really important that is it --

ZYDA: If you put that homework on Facebook it would be no problem at all.

[Simultaneous comments]

GOLDHAMMER: Go ahead. Finish your thought, please.

TWOHEY: The way that you want to design incentives is that everybody locally – like you get this global optimum but their local choice like makes their life a little bit better. And if there's some little reward or some little – if somebody publishes – says something at the start of their tenure at the NSF grant and it turns out to be right five years later and they get a little bennie for that, you know, maybe they get to go to Davos or whatever it is then people are much more likely to take this seriously.

GOLDHAMMER: Great. So, listen, I want to thank all the teams for your creative work over the past hour and a half, just amazing what the teams –

[applause]

GOLDHAMMER: Here's what the rest of the day looks like. Why don't we take about a ten-minute break now just to get a refresh on coffee, restroom, whatever you need, about a ten-minute break. We'll come back here just a little bit after 3:30. When we come back we're going to come back into our groups and what we're going to do – just let me explain it now rather than try to gather everyone back in tables. When we come back into our groups we're going to do two things. First thing is if you learned anything from other groups you have an opportunity to revise your model and add in – For example, if their output system you think you could really benefit from, front end, back end, you can put that in. The second and more important thing we'd like you to do is now to go back through the model and start layering in one more level of detail across three different dimensions. People, what people do you need to do the things that you say you're going to do. Technologies, what kinds of technologies do you think you need in order to do what you said you're going to do. And finally, partnerships, what kinds of either organizations or companies or institutions do you believe you need to be working with in order to do what you think you need to do. So those three categories: people, technologies, and partnerships.

GRAY: Have we captured these in their raw state before we go back and start potentially modifying them?

TALMAGE: Yeah, I really don't want to change what we have already done.

SAFFO: Why don't you take pictures before we come back --

[Simultaneous comments]

SCHWARTZ: We do. We can take pictures of this.

[Simultaneous comments]

Transcripts were not edited.

GOLDHAMMER: This doesn't have to be very complicated. You can add that layer of information in either with a pen or with a post-it note.

GRAY: What I was concerned about was the comment – if you've learned something from the other groups coming back and adding it to yours. Let's leave it where it was and we can consolidate that tomorrow.

[Simultaneous comments]

GOLDHAMMER: Time out, hold on.

SCHWARTZ: We need a clear set here.

GOLDHAMMER: Yeah, a clear set of instructions. There's nothing – I think we're on the same page with this, Peter, but let me just double-check. There's nothing wrong with innovating as we're sort of going along here.

LOUIE: I'm okay with that. So if people want to innovate – I'm going to follow Monitor's approach on this, I'm going to let you guys drive.

GOLDHAMMER: Thank you.

SCHWARTZ: Hey, listen, folks.

GOLDHAMMER: Listen, folks. Just so everyone's clear.

SCHWARTZ: Can we have one conversation, please?

GOLDHAMMER: This is an innovative crowd. When you come back after the break if you believe you want to do some tweaks, go ahead and do some tweaks because that's how we make the process better. Then the fundamental activity after we come back from the break is layering in one more set of data, which is people, technology and partnerships. You can use either your pens or your post-it notes to do that. We'll do that for about probably 40 minutes, 45 minutes and then we're going to come back to plenary to have a final report out. Are there any questions?

SCHWARTZ: Paul is going to take pictures of all of these so we'll have a version of this version already.

[Simultaneous comments]

GRAY: That's what I wanted to make sure is that I didn't lose it before we started hybrid…

[Simultaneous comments]

GRAY: I just think there's an inherent value of having this before we go back and –

GOLDHAMMER: Fine. Great. No problem.

Transcripts were not edited.

[BREAK]
3:15 P.M. – 3:30 P.M.

[TEAM ACTIVITY: IDENTIFYING THE HUMAN AND TECHNICAL REQUIREMENTS]
3:30 P.M. – 4:30 P.M. (SEE APPENDIX E)

OPEN QUESTIONS FROM THE COMMITTEE AND NEXT STEPS
4:30 P.M. – 5:15 P.M.

GOLDHAMMER: Okay, so what we want to do, there are a couple concluding activities we want to do. Lynn is going to be recording this conversation.

CARRUTHERS Thank you.

GOLDHAMMER: And so if you would speak slowly and articulate so that everyone can hear, that'd be fantastic. A couple of concluding points. First is just, and I don't want a formal report out from the teams but any observations from the different teams about either the human technical or partnership requirements for the system that you put together. And I'm interested both, if you have some observations about what were some of the decisions that were easy to make, like was it easy to figure out that this was 6 people and not 25 people, or the decisions that were also really hard to make in looking at these systems, what are the things that will need to be thought about. Yeah, Al?

VELOSA: So I think one of the things that we just didn't have time to really address was the really hard question of dealing with some of those soft signals, the fuzzy early warning things. That was just something that was, you know, I think it's the crux of the matter but we just didn't have enough time to deal with that I think. But I think for us one of the things that actually – for me was surprisingly easy towards the end was I think Paul threw out the number of a dozen and we all said yeah, that passes the BS test.

GOLDHAMMER: Yeah. And ultimately for this table the total number of people running the system was actually quite small. It was something on the order of maybe 20 total across all the different elements of the system. Peter?

SCHWARTZ: Yeah, I would only add that that's similar to what we, I think what we would've said. But I would say three things that I observed. One came out of our second order of conversation. In terms of an input source using a lot of people around the world that we already have access to, NGOs, soldiers in the field, contractors, aid workers and so on, finding ways for them to be part of creating these narratives that we're talking about. Second point is that on the whole, with one important exception, this isn't going to cost a lot of money. This is not a very big expensive enterprise. The one place where you could get into some significant money is any automated processing of general input data, you know, whether it's text data from newspapers or print and so on. That's where you could end up spending ridiculous amounts of money but almost everything else in this is fairly cheap.

GOLDHAMMER: Okay. Other thoughts, reactions from the tables? Jennie?

HWANG: I am still struggling with the time horizon. I mean, we, in this kind of output, we don't want to define exactly the time. However, you know, are we looking for the infinite time or looking for the reasonable way to define the timeframe? That would give us -- Because everything is [..?..]. If we give infinite time, that become perhaps too early. Very extreme, you know, come out more toward very wild imaginations. But then if you say too short term, then we really don't limit ourselves. So what really are we trying to balance that? What is realistic? You know, because this is different approach, you know, when you look at it. If you give infinite time, that's an entirely different world.

LOUIE: I think I have two parts to the answer so first is from a customer's point of view who happens to be our sponsor, the Department of Defense. It doesn't mean that that should be the driver but it is a point of view. So given the traditional planning horizon of the Department of Defense, what they're looking for is a valid – multiple valid approaches forecasts, what they may encounter somewhere between 10 and 20 years out.

HWANG: Okay.

LOUIE: Because it kind of takes that long to build things, employ things. It isn't that they're not interested in the shorter terms but they have lots of different systems that they can use in existence as -- You know, the longer term affects the big, bets, the multimillion dollar systems that they're buying and the world in which they think they're going to operate in, what's that going to look like? That's one person's point of view. I think and at least of the three approaches, all three assumes that there's value to more than just to the Department of Defense and so the time horizon in some ways is a little bit more murky. What is useful is can you provide a way of looking at the future that people can begin to track, monitor and bet on and change those bets as new information gets discovered. And so, you know, it'd be different for an IT company, you know, the time it takes for software to be developed is a different time scale horizon than maybe something that takes serious infrastructure. I mean, if it's energy, we're looking at a 20, 25 year infrastructure, you know, things aren't going to change, you're not going to unplug the grid tomorrow, you know, even if there is a better solution this week. So it really depends and in some ways that's why it's left a little bit fuzzy, because if we locked it down to the Department of Defense needs, that would help us on one end but would hurt us on our ability to get others to play with us and make this thing be a really useful [..?..].

HWANG: Well even if it's a fuzzy when, not, we still have kind of scale(?) when we talk about 10 or 20 years, maybe 30 years. And we're not talking about 200 years, you know.

LOUIE: No, no. We're thinking about more like two or three product cycles, whatever that product cycle [..?..].

[Simultaneous comments]

GOLDHAMMER: We can do Ray and then come over here and then here.

STRONG: So just in answer to that though, one of the useful things to do is to go out and look for ideas where people are, where you tell people to think 200 years out and then backcast from those. So you're backcasting into that range that's say beyond five years but not, not maybe, probably -- we can't do any kind of predicting about what -- when you say 20 years or 30 years, there's no difference. We have no difference between 20 and 30.

LOUIE: Ten to 20 does.

STRONG: Yes, but when you're just outside the [coughing] you can say a little more.

GOLDHAMMER: Michael?

McCORMICK: This is a personal observation that I have, is for all three of these systems the management of the systems is actually one of the weakest links.

GOLDHAMMER: Yep.

McCORMICK: There's a lot of shall we say bottlenecks where you're only as good as the weakest link in it and, you know, making sure that you're keeping high quality people, you know, keeping the feedback loops working, etc. So it takes a lot of active management for all these to actually work well.

GOLDHAMMER: Harry, then Peter.

BLOUNT: I have a question for the people who are not on the committee, which is in your experience, now that you've had a full day to kind of assess and hear the problem statement and some of the thoughts that go into it, have any of you guys seen within your domain of experience any organizations out there globally or tools or processes or companies out there globally that have a lot of the key elements in place?

GOLDHAMMER: Yes.

McCORMICK: Yeah, I mean, almost all the major Fortune 500 companies have these in place. Now the thing I would say is again, one of the biggest issues that comes into play is that information isn't communicated particularly well and they're not particularly managed well.

BLOUNT: They have processes internally to forecast disruptions?

McCORMICK: Yeah, especially in high tech. I mean, IBM's a really good example. I actually helped develop a [..?..] business at IBM and one thing that's really interesting about it is there's a lot of people and a lot of process that go into it and it's surprising how poor the output actually is.

GOLDHAMMER: Yeah, I'd say yeah.

CULPEPPER: In our business we have a team that specifically evaluates inbound technology in the [..?..] world. And because we're a relatively large player, we're a big fish in a small pond, right, so a lot of players come to us. I think I mentioned this, yes, this whole idea of a gravity well. Like people come to you because you're relatively large in a given segment. If you've got that then you've got a unique position because people are going to bring things to you just by virtue of the fact that you can make a difference in their particular application area and it gives you a front end view of the entire market. I wouldn't say necessarily we do a great job of then taking that and applying it even inside our own

Transcripts were not edited.

business yet, but it does put us in a unique position. And I think this has the potential to be that same kind of structure but you've got to identify how do you generate that gravity well on the front end. There's a lot of other tools too out there that do things for example like tracking word analysis, just saying what's going on in the media anywhere where I'm mentioned. I mean, some of it's as simple as Google. There's other more sophisticated media tools that really strip down content and give you digests on this is a good article, this is a bad article, you know, what happened here, by market, by segment, by state. You can really tear down a lot of information very quickly. So there's a lot of tools out there that can be tapped I think.

GENIK: I'd quickly say that I just completed a report, "Opportunities in Neuroscience for Future Army Applications", that just got published this year and one of our overarching conclusions was that we need this kind of a capability in neuroscience research for military use. We didn't use the term "disruptive" and we didn't say that but the kind of group and the kind of system that you're designing here, actually, when I was asked to be here last Friday, I thought it was part of forming the group finally, starting off. But I would say -- so my answer is no, in neuroscience future there is not a current type of group like this.

SCHWARTZ: I want to go back to the question of management that you raised, Mark, which is in our group we talked about the need probably to have at least more than one parallel structure, one that is very visible and public and then probably one that is either classified or private. We talked about the differences between the two and without getting into all the nuances there, but something that is not as visible where things can take place and conversations and inputs and outputs can take place where you have to be at least discreet, you know, at the level of corporate NDAs if not, you know, top secret.

GOLDHAMMER: Yep, Gilman?

LOUIE: You know, we've played around with this concept in other agencies, that we actually formed a Disruptive Committee. There was a notion that there would be kind of two separate organizations, that we thought that maybe there would be a need for a nonprofit, multi-nationally sponsored, countries, corporations, individuals, whose job it is, is just to produce really interesting forecasts, regardless of how people are going to use it, which is kind of the honest broker, individual, and that there may be a separate group inside the Department of Defense as well as in corporate entities in other places, who will learn to leverage this, kind of bridge open source collection of forecasts and disruptive technologies and apply it to whatever their needs are. But the danger, if you tried to put both those groups into one, is you immediately re-bias both the questions and the outputs that you have. There was a notion – we have no proof that that's a good idea, but there was a notion that [..?..].

GOLDHAMMER: Yes?

WINARSKY: So this conversation's really interesting to me because what we've just heard -- what's your name again?

CULPEPPER: Mark.

WINARSKY: -- Mark pointed out that Fortune 500 companies are, all have similar needs. Let's put it that way. And what that means is if we do our job right, this is going to be extremely interesting to them too. So, you know, the analyst's question is perhaps private to us, you know, can we, when's the next time a micro satellite could be launched by, you know, another nation state for other purposes, that's our question. But the issue of satellite launchers and when it will be commercial and people who manufacture that, that's going to be interesting to them, venture capitalists, everybody. So what this means is, is if we keep it open like this, it will become an important element of everyone's tracking of innovative and disruptive technologies and -- But what you've got to keep is your own questions potentially to yourself.

CULPEPPER: Yeah. And sort of the corollary there too is it also becomes a target for deception. Because anything that that's interesting to that many people will have implications, financial implications on markets, on governments and what militaries may do in different parts of the world. It becomes very interesting.

McCORMICK: Can I add to that?

CULPEPPER: Please.

McCORMICK: Most of the major corporations that I've been involved in doing this stuff with have exactly that, they've got a marketing arm on the side on okay, what are we going to publish, what are we not going to publish, how are we going to do this. There's a hell of a lot of positioning that goes on.

WINARSKY: Right. But given that we're open, if we can open source this, you know, crowd sourcing this information, then you have a self-correcting mechanism against deception because whoever is on the one hand saying, "This isn't going to happen for 15 years," while they really think it'll be three, then the people that think it'll be in three might actually come back and correct that.

UNKNOWN: There's still a lot of game playing.

NOLAN: So it seems that a lot of our thinking assumes that the creation of disruptive technology is a process that kind of happens independently and then we, the system, are able to monitor it. I'm wondering if there's any thought as to if this system goes open source, how that affects the process of creating disruptive technologies.

LOUIE: To kind of further that thought. I mean, one idea – we found this on the open software environment, is once you start opening up ideas, what happens is it motivates its own self. Good ideas have a way of amplifying themselves. And so in some ways creating such a system might actually get people to focus around certain very interesting, potentially highly disruptive technologies to solve either really, really knotty problems or to really explore big market opportunities. And, you know, it's sort of a twist on kind of the venturing side of the world when you look at signpost venture capitalists and, you know, "What are Sequoia and Kleiner betting on this week?" Maybe we should pay attention to what those guys are doing. That's another kind of system. Another comment on the deception. Deception is highly valuable. In other words, for somebody to want to deceive you into believing something knowing that there's a lot of activity around that, even if there's a lot of false signals, it's telling you something, that this is, somebody's trying to steer you in a different direction. That's also very, very useful. So in some ways, you know, the harder thing is when you have no signals at all. But, you know, deception can be used very positively in the analysis world.

Transcripts were not edited.

GOLDHAMMER: Mark?

McCORMICK: I just want to add one thing to what you're saying. I think one of the things that's interesting about the open software environment is the ecosystem around a particular technology develops twice as fast as ordinarily and it's often adoption has more to do with not the raw technology but the ecosystem that goes around it.

BLOUNT: I think very quickly the open source model, you also see where converging ideas come in. So you're able to track that because you can see, even online you can track people that are kind of pairing up with this idea, this idea, this idea. "Let's go offline and do this together."

GOLDHAMMER: Stan, did you have a comment?

VONOG: Yeah, I thought one of the areas was international participation, probably motivate people to perhaps participate in this thing. And Gilman's was, sounds like a viable proposal, like [mike noise]works. They have like 27 countries they are building thermonuclear whatever could blow up whole thing into black hole. [Laughter] But it works so maybe it's the right [mike noise].

[Simultaneous comments]

SAFFO: Well it doesn't work yet but [mike noise] perfect.

VONOG: Yeah, no, I mean, the system of scientists from different countries working on like some venturists.

GOLDHAMMER: One, sort of one uneven I think opinion I'd like to surface a little bit is how, if you look at this thing in total, you know, and we've got three different systems here so sort of based on your team's perspective, how much of this – I'm going to oversimplify here but how much of this set of activities is done by people inside the government or associated with the government in some meaningful way? How much of it is done by people outside the government or not affiliated with the government in any meaningful way, they're part of a private enterprise or nonprofit organization that is not connected to the government?

SCHWARTZ: 99 to 1.

GOLDHAMMER: Good, thank you. 99 to 1, meaning 99 out, one in? Do people agree with that?

SCHWARTZ: Well, we've got some guys inside, we've got some staff. We've got people working inside, some analysts and --

GOLDHAMMER: I'd like to know where the agreement or disagreement falls. Mark, I see your head nodding.

McCORMICK: Yeah, I think the majority of it's got to be external.

GOLDHAMMER: It's out.

McCORMICK: There’s too much -- and the thing about it, the more variety you have in the more locations, the less likely you’re going to have the bias issues that are built in.

UNKNOWN: Yep.

TWOHEY: I think you probably get the people inside the government participating 'cause they see this as a channel to get around what they perceive as bureaucratic roadblocks to getting their ideas published. So you’ll get, you know, you’ll get exactly the dissenters, right, because if they’re being listened to already you don’t need this.

GOLDHAMMER: Anyone who significantly disagrees with the 99 to 1 rule?

LOUIE: Well I can look at recent history, right, to know that if it catches on commercially or in an open source world people inside government will take a version of that, morph it and use it for their own internal use. So I look at, you know – Intellipedia is a good example. You had to have Wikipedia prove itself out before government would say, "Oh, we’ve got to go off and use this 'cause we’re behind this." If you’re leading the charge, the problem inside government is you’ve got all of these inhibitors who say, “Don’t do this, don’t mess up the system, don’t change the organization, don’t threaten the status quo” and more importantly, in order to do a lot of these things you have to change your complete security protocols to allow this to happen. So in some ways, if you really want to motivate change inside the government, you always have to do it by example on the outside. It’s not always the case but just recent history it seems to be more the case.

GOLDHAMMER: Yes, Stan?

VONOG: I could say my impression about Russia and I don’t know for sure but my impression is that 99 inside the government, one outside. [General laughter] And it’s a kind of simple process. They decided it’s going to be nanotechnology and putting like 15 billion, whatever, so there is, like they probably listen to what’s going on in the world and then we’re going to pick one. That’s going to be the next sort of space or science [..?..].

[Simultaneous comments]

McCORMICK: There’s just one other thing I was just thinking about along those lines. Somewhere in the process I think there needs to be a level of anonymity. That involved in it which takes away a lot of the politics that okay, here’s somebody with, you know, "I’m a General and you’re a lowly private" type thing, whereas, you know, some of the best ideas we’ve talked about often come from the least obvious person. So it allows the best ideas to surface, not the title they service.

GOLDHAMMER: That’s a good point. Just another sort of striking a balance question, so we talked a little bit about deep government, inside or outside. So this is a system for identifying disruptive technologies for the Department of Defense. One could imagine that even if you were identifying these technologies in open source they may have capabilities where one could imagine an organization that’s 99% outside the government imaging capabilities which are pretty interesting, the kind of capabilities that most people inside of the security and defense establishment would consider to be classified or certainly wouldn't want anyone to talk about. Can you guys give me now a sense of like how much of the work of this entity, this organization, this system, how much of it is cleared, how much of it is classified – excuse me – how much of it is unclassified?

Transcripts were not edited.

LOUIE: And after the first accusation of a leak or second [Chuckles]

NOLAN: Let me tell you a completely fictional narrative. It's 99% private sector or not-for-profit, 1% government. A couple ideas show up creatively which happen to be the same as some highly classified U.S. government program. I can easily tell you the story about how a lot of that stuff gets dragged behind the firewall.

GOLDHAMMER: You don't mean the GDN Climate Report? [Chuckles]

NOLAN: I don't mean anything in specific. I'm very cynical about the ability of our national leaders to tolerate the ideas that they consider secret also showing up on the outside.

LOUIE: There's a different twist to this and it's always delicate. Anybody who's cleared today and puts anything on this network is going to get shot, right, at least on the external. You do – on the internal, well you do whatever you want. And anybody who's stupid enough to put something out there probably should be shot. The flip side of that, for any other country, including our own, I did – other people are having this same line of thought that is extremely useful in preparing against surprise, right? So if you thought you were the only guy who thought about a particular problem and you thought "Oh, wow, let's classify and make it secret," and you find out ten other people who were just kind of chatting about this on the side also shared that idea, you'd better know about that. We had the same problem when we were thinking about Google Earth. Here's the CIA making an investment in a startup company that put SAT data available to anybody on the Internet, [..?..], a CIA investment, right? And then we sold it to Google, right? We went through the same issues. "Oh, my God, what would happen if the bad guys get this?" Then we said, "But the bad guys probably already have this."

McCORMICK: But wait a minute. But the Russian data was already available on a Microsoft terra site.

LOUIE: Exactly. I mean, so sometimes we worry about things that we shouldn't be worried about and there are other things we should be worried about but it's also you should know that other people are thinking about those same lines. So I would just put the DOD hat on to say in this kind of open source world is it's really important to understand other people, particularly non-nation states. Because, you know, a Chinese analyst is not going to put her secrets up on the system either, right? So if other people who are not outside the normal nation states that we worry about are discussing this, I think we want to know about it.

TALMAGE: So another question would be if you wanted this to be running without the DoD piece in it but just out in the open

SCHWARTZ: Without the DoD what?

TALMAGE: If you didn't want this to be in the DoD piece but, that this be an open product, what would be needed? Would it be a foundation, would it be an X Prize group? Who would run a data collection unit like this?

SCHWARTZ: Well, the truth is I actually think the National Academy is not a bad organization to run it in the following sense. Part of what we recognize is that one of the things that participants want is a good audience, i.e., people that matter or are interesting or important, to listen to them. And the National Academy has the sufficient stature to be such an entity. It could be others but it has to be something that is in itself an incentive for people who wish to participate.

WINARSKY: Well and so we, I mean, that's what our group was talking about, right, such as even something so simple as movie productions, a 5-minute clip, if you're, you know, if you've reached a level that people recognize that really looks like a disruptive opportunity, we're going to put it out there and Spielberg is going to, you know, base a script on this or something. So I mean, there's lots of ways to incent people to contribute. You know, that's very, very different than a scientific contribution.

GOLDHAMMER: Mark, Phil and then Danny.

McCORMICK: I actually really like your idea of the X Prize.

DANIEL: I heard it in one of the groups. That's why I asked.

McCORMICK: Actually, I think that's a phenomenal idea 'cause it gets to the heart of motivation of competition, you know.

GOLDHAMMER: Yeah.

NOLAN: Well let me just throw out another, a very different sort of general observation about the three systems and we talked a little bit about it in our group. The efficiency, the throughput, the speed of these systems, one imagines that that's going to be a very important characteristic and also that might be where the lever of, the resource lever is going to help you determine whether – and I don't know whether we talked in our group whether it's a dozen people or a thousand people running this organization, but one imagines a play on that lever can increase the speed and the throughput and I imagine within some pretty broad ranges. So that's a place where the DOD client may be very helpful in thinking through where to target.

GOLDHAMMER: Danny?

GRAY: So, and this is a question to Daniel and that is what is the likelihood of contacting other nations' equivalent of the NAS and say we would like to do this initiative and, you know, and invite participation in bringing something together so that it's not seen as an American science initiative to introduce or to identify disruptive technologies. And then that brings your buy-in where you can say we've gotten rid of the American bias, you know, at least to some extent, because we've invited participation. And basically you could kind of put this into a – I guess a national cooperation race where nobody, no nation wants to be seen as not contributing to this because this is a group science mind think system.

TWOHEY: So people start talking about incentive systems, like --

GOLDHAMMER: A little louder.

TWOHEY: People are talking about incentive systems like there's only one and I think that that's flawed thinking, right? Like why have just one, you know, like why not take a diversified portfolio, have a prize, have an organization, have movie credits, have all these things

Transcripts were not edited.

and, you know, try them all. The things that work, keep them, the things that don't work, throw them out. And then you have this committee, right, and part of the thing about being on the committee is you should come up with new, exciting ways to incentivize people.

SCHWARTZ: like a Nobel --

GOLDHAMMER: Great. Paul and then Jennie.

SAFFO: You know, the Office, the Congressional Office of Technology Assessment, was not -- [General laughter]

[Simultaneous comments]

SAFFO: -- it was simply defunded. They never eliminated it. And the shell is sitting there.

SCHWARTZ: Does it still formally exist?

SAFFO: It still formally exists. It just doesn't have any money. And so it sounds kind of like a Frankensteinian portmanteau kind of construct but, you know, if you sucked it that in with the NAS it would give you the kind of political cover that would protect you against members of Congress. So next time Peter doesn't get beat – I'm sorry; I won't talk about that – but it's, I know it sounds impractical in many ways but --

SCHWARTZ: Brilliant. Do it.

SCHWARTZ: If there were an OTA we might not be having this meeting.

UNKNOWN: Yeah, yeah.

HWANG: I just wanted to add on a couple topics discussed here. One is about the open source, outside/inside the government, the other DOD, the other is international involvement. In my engagement – for the last twenty, I think so, twenty years is kind of a break point. Before that then the DOD really had different principles, you know, from the last twenty years. I think the early 1990's really break point, the principle is really intended delivery wanted to have outside to really test out whatever the technology concept was and really, you know, put us a criteria. You know, we were not going to adopt anything until commercial sector were really able to prove it, you know, it is real viable. So, you know, that's one thing. [..?..]break point, about twenty years. I would say about the 1990's. Ken, you know, you can make a comment on that. You were directly in that. My involvement is really, you know, kind of like that -- [..?..]. Okay.

PAYNE: I think -- I'm sorry. Go ahead.

HWANG: Okay. I just wanted [..?..] get off on this. And not only international involvement, almost all National Academies committees deliberately invite international members' participation if it's feasible. Feasible means we can identify the people. So always, you know, has international involvement, at least the committees I've been with there's always, we have some international. So that part is not, it's almost like standard practice. So anything comes out of National Academies I have to – I think I can say, we always have some element of international.

Transcripts were not edited.

GOLDHAMMER: Great. Ken, did you want to say something?

PAYNE: No, just Jennie was asking me – it was in the nineties they kind of went to, you know, "Oh, wow, we want to go to the commercial off-the-shelf as much as possible" and, you know. Now they did it wrong. They get something – they get a system like SAP, which, you know, makes you change your business process, but then they'd hire somebody to build like bridge software so they could still do it the way they did it before. [General laughter]

[Simultaneous comments] [Laughter]

PAYNE: I was in there. I saw it happen. I mean, very important, made a lot of money off of [..?..] on that. But, you know, I was like, "Why'd you get SAP in the first place? Why'd you get a software [..?..]?" You know, but commercial off-the-shelf was one of those things that – and, you know, good reason. I mean, it's proven, your timeline is not that long, you know, as long as you use it right it's not that bad. But as typically happens in government a lot is that they go overboard with it. And so like Gilman says, they wait 'til it's proven outside then they say, "Okay, yeah, we can use it," because people don't want to be culpable for anything. And for a group of people whose jobs is pretty secure, are pretty secure, it's amazing how risk averse they are. [Chuckle] But –

SCHWARTZ: That's how they protect their security.

PAYNE: Yeah, I guess.

[Simultaneous comments]

McCORMICK: This one might be kind of controversial and it's a little bit out of scope in some respects but it just strikes me -- I had a long conversation with a VC this past week and I thought it was a pretty interesting conversation from the perspective of we educate some of the – most of the Ph.D.s around the world in the United States and then our current process and our current thinking is, you know, we make it almost impossible for them to basically get a green card and a visa to stay in the United States. In some respects, if we give somebody a Ph.D., we should be giving them a visa to be able to stay and keep the innovation here and make it easier to monitor at the end of the day.

SCHWARTZ: That's what we used to do.

McCORMICK: Yeah, I know and we don't now.

TWOHEY: I actually have this issue right now in a startup I'm doing like today, I mean, like this is a real issue.

UNKNOWN: [..?..] has it too.

VONOG: Well, I would say it's much better than many other countries, the visa system. So in places like Russia it's just like tourist visas, working for [..?..], [..?..] Russian citizens, and I studied there for eight years so it's a bit of a pain. And if you want to work it's just like… So it's not that bad. And in a way if you're a great Ph.D. you can always find work here if you want to stay. It's not a problem really.

Transcripts were not edited.

McCORMICK: It's getting much harder.

[Simultaneous comments]

VONOG: I mean, all my friends who are Ph.D. wanted to stay in the United States.

GOLDHAMMER: Do any of the committee members have any specific questions or issue that they'd like to raise in the time that's remaining to us here? Yes, Harry?

BLOUNT: One of the things that I'm not sure I heard from any of the tables in detail was – yet we ranked it highly I think on everybody's sheet, was this concept of anomaly processing. And I think we only superficially touched on it and I guess the question is if we're going to successfully run a platform with very few people, that means you've got to have some very effective anomaly processing tools over time to do this. So did anybody hear during the process or have some background in seeing tools that are very, very good at processing the edges?

STRONG: Well, part of the process that's there on table two is a process of, number one, identifying measures of interest and then, number two, doing general monitoring of those for statistical anomalies. And that is a – it's a built-in part and it is pretty much automatable.

BLOUNT: And is there something out there already?

McCORMICK: There's a startup ten blocks from here called Twine that –

BLOUNT: Twine?

McCORMICK: Twine, and they're working on some really interesting stuff. If you want me to, I'll introduce you to the CEO.

STRONG: It's, there are, yeah, there are a lot of people who are doing this kind of thing.

McCORMICK: There's a massive amount of research going on between Google, Twine, Bing, I know Yahoo!, a couple like that that are doing.

TWOHEY: There's a guy, Ron Conway, he's a venture capitalist, his whole thing is, you know, real times. If you hit the real time local trifecta you're going to get a bunch of seed money from him. I mean, not necessarily for sure, but –

[Simultaneous comments]

TWOHEY: What I'm saying is that there's a lot of investment in, you know, different kinds of search things. It's not just -- there's another search engine that just raised I think a couple million dollars in funding this week. I mean, like people are still actively spending money, private money, trying to make a better search.

McCORMICK: Bottom line, there isn't a pre-packaged tool you can go out and buy today but there's a lot of stuff out there you can put together.

VONOG: I'll bet you can tune up Google engine so it finds like lists, you know.

Transcripts were not edited.

LOUIE: Let’s not forget the power of humans. You know, one of the things about the Internet is that it enables mechanical [..?..] to really be a very effective system. And so, you know, as good as the algorithms are and there's some really great stuff out there, probably the -- I looked at table 3 and I say to myself, you know, the brilliance of that is, you know, they’re not – unlike our table, table 2, as "Oh, we'll rely on technologies" 'cause they let the people out there use their eyeballs and their minds to rise things up to the top. There’s huge value in that. You don’t have to do everything by traditional automated processes if you use the network appropriately and you use kind of systems in a very effective way to serve up useful information.

McCORMICK: Like humans are still the best engine for figuring out anomalies.

UNKNOWN: Yeah, and if you’ve got, you know, a million of them, it’s a pretty good engine.

UNKNOWN: Yes.

GOLDHAMMER: Harry, did your question get answered or…

BLOUNT: I think so. I mean, I think, I agree whole heartedly with Gilman, is that we haven't come up with a machine or algorithm that can do a better job of pattern recognition than we can. I think that’s part of it and I think how it’s displayed, lots of information is displayed, which we really didn't touch on either.

McCORMICK: Well actually to add to that, I think one of the biggest issues that I think exists today is not the analytical tools or the people and stuff like that. It’s actually the display. You know, the UI to be able to still filter through vast amounts of information, you know, in a efficient, economical way. That’s probably one of the biggest [..?..] right now.

GOLDHAMMER: Norman, did you have a comment?

WINARSKY: Not a comment but another question to the group.

GOLDHAMMER: Great. A little louder.

WINARSKY: The question is, one of the issues that I see is measures of success. I mean, people have been talking about giving prizes and things like that. On the other hand, we’re looking at ten to twenty-year horizons so how do you -- what does the group think about how you decide if you’re doing a good job?

GOLDHAMMER: Please, Ray(?)?

STRONG: I have a comment on that. Rather than talk about making accurate predictions, which will take ten or twenty years to measure and it isn’t what we’re all about anyway, I look at measure of success is the breadth of preparedness that’s represented by the number of things that you’ve considered, the number of different things and the breadth of that, you know, what it covers that you’ve considered and you have plans to act on if X happens. So it’s being able to, you know, if somebody, if there were somebody who were to generate a question, “Do you have a plan for if a meteor strikes?” or, “Do you have a plan for…?”, you know, generate lots of those questions and have those questions come in, and the measure is what percentage of those questions do we actually already have

Transcripts were not edited.

covered by the system and what percentage of the questions will get covered by the system as the system matures. So that's a -- it's not are we successfully going to predict a meteor strike. That's not the point.

GOLDHAMMER: Paul, did you have a comment?

SAFFO: No.

GOLDHAMMER: Okay, Mark.

McCORMICK: I'd actually like to add something to that. If you think about it, as soon as you figure something out that you didn't know you didn't know, it changes your thinking, right? And just by having a constant stream of that emerging, you know, it actually makes you more aware. It changes how you make decisions, it changes how you view the world.

WINARSKY: So I agree with that. So how do you quantify that?

McCORMICK: Well it's, you know, to a large degree it's the efficiency and effectiveness of what we're talking about, is the ability to be able to identify what you didn't know you didn't know. That's the fundamental problem I think we're talking about here. It's not what you know you don't know 'cause let's face it, there's tons of that stuff that's out there.

LOUIE: You can measure it by – 'cause, you know, at the end of the day a forecast has to communicate, it has to drive some [mike noise]

SCHWARTZ: See, I think that's the measure of success. Do people respond – is the quality sufficient that it motivates a response? And if the answer is it's too abstract or unclear or too far out, you know, then nobody takes it serious. It's not a success. It's a success if it motivates an appropriate response.

NOLAN: Well wait. I'm worried about that because --

GOLDHAMMER: Yeah.

NOLAN: -- a very plausible sounding narrative can motivate action when –

SCHWARTZ: It could be wrong.

GOLDHAMMER: Yeah.

SCHWARTZ: It could be wrong. There's no guarantee that you're right. That's why it's not the accuracy 'cause you don't know that. The question is does anybody take it serious enough to do anything about it and you may be wrong. That's a risk you take.

NOLAN: It feels like there's, in my mind, maybe quite a step change between what Ray's talking about, which is identifying something clearly enough that you could think through the response and motivating people to actually take more action against it.

SCHWARTZ: Yeah, I'm going one step further. It isn't simply the understanding. It's actually, it motivates – okay, we're going to go launch an R&D program in X; we're going to focus attention on monitoring Y more deeply.

Transcripts were not edited.

UNKNOWN: Yes.

SCHWARTZ: If it produces a response, then it’s a success.

NOLAN: That sounds like a [mike noise] incentive program.

UNKNOWN: It incents hype.

SCHWARTZ: No, I -- we can talk about this offline but I don’t think so.

[Simultaneous comments]

WINARSKY: My worry about that approach is, you know, if we had predicted two years ago that the banking industry would mostly collapse, the persuasion of people to act on it is not a good measure but still might have thought it’s very unlikely, you’re crazy. So in some sense we want --

ZYDA: Had you announced that you would've had the Secretary – the Fed making sure it collapsed bigger than it did. [Chuckles]

LOUIE: Yeah, but it isn’t that you’re just taking action. You know, I want to blend these two concepts together.

SCHWARTZ: I completely disagree with what you said, Norm. Let me just -- I think you’re completely wrong. The Federal Reserve should have had and did have until 2004 a group whose job it was to anticipate financial crises. And in fact Greenspan eliminated the group in 2004 'cause no financial crises are any longer possible. This is not a possible future event. We now understand markets so he eliminated it.

WINARSKY: In the Greenspan world this would not have been taken seriously.

SCHWARTZ: Well my point is simply that in fact that entity ought to have had a group who said "What would happen if?" Now they don’t go out and publicly say, “Hey, we’re worried about Lehman Brothers.” That’s a different question. But they’d take appropriate action in anticipation, monitor it closely and if they see it beginning to emerge they act in a timely way. So in fact I think it is quite plausible.

LOUIE: It is, it’s --

GOLDHAMMER: Gilman, go ahead.

LOUIE: Let me just finish that out, which is I want to blend these two concepts together 'cause I think the value is in the blending of these concepts and not one by itself. That is successful forecasts should provide a roadmap of potential future outcomes that is actionable and trackable.

SCHWARTZ: Right. Bingo.

LOUIE: If the event never takes place, you should see it in the signals because you’re not hitting those signposts.

Transcripts were not edited.

SCHWARTZ: That’s right.

LOUIE: If you’re hitting signposts or there are new signposts being hit that you didn't even think about, that’s going to tell you something about the quality of the forecast.

SCHWARTZ: Exactly.

LOUIE: Okay, so it is not that you actually spend money and it’s not necessary just the hype cycle, the hype is fine as long as you can map it out so you can say, "You know what, based on what we’re tracking, it’s hype," or "Based on what we’re tracking, oh, my God, the Chinese are on to something," or the Americans are on to something or Google is on to something because they’re hitting these target – these measures of interest are beginning to click off. And then ultimately to have the plans in place to say, "We have enough of these milestones that we’ve been hitting, these signposts that we’ve been hitting, and these units of measure, that we’d better start putting together plans," right? So that’s what I consider a successful forecast.

SCHWARTZ: Exactly.

GOLDHAMMER: Comment over here?

TWOHEY: I just want to know, so what were people -- so it’s twenty years after 1989, right, so there’s this – and in the late Eighties there’s another financial crisis. You know, people were always worried about these scenarios. So do we have any data to backtrack what we did twenty years ago and whether it worked or not? I mean, because it seems like we’re making this entire discussion here --

UNKNOWN: We repealed the [mike noise].

[Chuckles]

TWOHEY: Wait. What I’m saying is this entire discussion we’ve had here, right, has been divorced of feedback mechanisms for things that might have happened a while ago. So maybe we should list those and like see what worked and what didn't before we just guess.

BLOUNT: So I spent a lot, spending twenty years in the financial markets I spent a lot of time looking at this and you get into the risk and the opportunity. It’s useful to look at history as long as you don’t try to tightly model history.

LOUIE: Right. A good one is the Saddam Hussein’s weapons of mass destruction. So if you think about it from an intelligence analyst point of view, the number one failure prior to that was our inability to track nuclear weapons testing in places like Pakistan and India because we fell susceptible to deception. So here comes this guy who used to have nuclear weapons we know is a chronic liar saying he doesn't have them, all right? So the pattern is okay, "Last time we screwed up because we didn't catch the liar. We’ve got a known liar and he’s saying he doesn't have it. Therefore it must be a lie. Therefore he must have it." You can construct a model to prove that he potentially could have it based on the same set of facts that would have proven that he didn't have it. So there is a danger, and this is the dangers that experts run all the time, is they assume the past is a predictor of the future. It's something you should look at. You shouldn't be ignorant about it, but it's not necessarily a predictor.

TWOHEY: I'm not saying we're – like it's important that [..?..] were successful or failed in the past but just what incentive systems did we use and what outcomes did they produce. Because if we used incentive systems and the outcomes all sucked then we shouldn't go use the same incentive system again.

McCORMICK: Well, so we're basing it on behavioral, what's the behavioral --

TWOHEY: That's all I'm saying, is just maybe like looking at that might be worthwhile.

GOLDHAMMER: We are almost out of time here. Gilman, did you have any final questions that you wanted to ask to the group?

LOUIE: So one of the things that we'll get tested on, you know, when we write all this stuff up and we go through it tomorrow is we get evaluated by groups of experts who will come back and ask the question "Now this is really all interesting but it doesn't seem possible." So my first question to you is, you know, kind of going through all these interesting approaches, is there anything in your mind that says that any one of these activities or potential approaches is an impossible act just to do, right, just to be able to construct an organization, whether it predicts good forecasts or bad forecasts, is there anything in here that you worry about that is a show stopper that we're kind of assuming that could easily happen, that an expert would come back and say, "You can never produce this forecast because this is an impossibility?"

REED: I think the time horizon is way too long. I mean –

SCHWARTZ: I'm sorry. We can't hear you.

REED: Oh, sorry. The time horizon, the incubation, the period between the creation of the technology and the time at which the technology actually causes a disruption can be less than ten years. And so you're not going to -- how can you forecast out ten years?

McCORMICK: I think it's also going to depend on the vertical that you're talking about or the generation you're talking about.

UNKNOWN: Yeah, yeah, agreed, agreed.

McCORMICK: So some, yeah, it's a six month horizon, some of them it's a twenty year horizon.

REED: Right, I agree, I agree. But I think a lot of the big ones that we've seen lately, like the Twitter in Iran --

McCORMICK: Oh, social media.

REED: Yeah. How could -- I mean, granted, you could have predicted it maybe a year or two ago but I mean, ten years ago there wasn't even Twitter.

McCORMICK: I think actually one of the big dangers with it is not so much this stuff is not possible, it's that things like that that people would externally say you should have been able to predict

Transcripts were not edited.

that you couldn't predict and therefore your system is fundamentally flawed. There's almost like a political thing that's got to go around this to say, "Hey, this is not perfect."

UNKNOWN: Yeah.

GOLDHAMMER: Stewart, question, comment?

BRAND: Just wondering how you can – make sure you've got some early wins. If this thing doesn't have early wins and the promise of early wins, why the hell fund it?

LOUIE: Well the argument that we consistently run up against is why is this approach better than talking to a group of experts? They're experts. We can trust, we can look at their Ph.D.s, we can look at their prior success and expertise in the field. Why is a group of crowd source experts, foreign nationals who are prone to deception, going to produce you anything useful relative to the existing approach? That is a question we're just going to have to deal with. That's a question that we're going to be facing.

BRAND: Well think about it. The early win there is you've got these incredible people, great experts. They're in the room, they're talking to us. Wow. So you've already got a kind of success story right there even though the product may be irrelevant. So I'm trying to figure out a way to – how do you make the --

GOLDHAMMER: How do you redefine success?

BRAND: -- how do you redefine success in a way so that you can go along for five years without any disruptions to report. I don't know, do you retro-predict stuff that already exists or things like that? It's an interesting design problem. Well, how do you get a project, a long-term project like this, funded.

SCHWARTZ: And sustained.

[Simultaneous comments]

McCORMICK: I want to come back to your, the business model question. There is one thing I was just thinking about that's not the short term but long term. If you take the premise that there'll be more technology, which is proven out in history, there'll be more technology introduced in the next ten years than the previous one hundred and that's been true for almost every previous ten years that's existed. At some point the scale of innovation, the scale of information that comes into this process gets to be almost unmanageable, you know. And right now it is manageable but at some point you do need to start looking at automating some of this stuff. You know, I think that's probably the bigger issue. It's you're kind of, as an organization, you're behind the eight ball to be able to keep up with the level of innovation that's taking place.

LOUIE: I think that there's another inherent problem about disruptive technologies. Until they actually appear and become disruptive they're fundamentally unbelievable, right? You can never predict at a hundred and – what's the Twitter limit, 142 characters can change the world. It's like a stupid idea. It's the dumbest idea out there and all of us VCs who saw it thought it was a stupid idea.

McCORMICK: Well eBay's another one. It's like, you know, what are you going to do, a yard sale online? All of a sudden boom, it becomes a new channel.

GOLDHAMMER: I think one other thing I noticed just in the conversation, which may in part answer your question, is I think, at least on the technology end of things, there are actually quite a few things that are quite doable either algorithmically or through some other kind of technology. There are lots of different experts configured in lots of different ways who can answer a lot of these questions or can evaluate hypotheses or can generate narratives. But the part of it that, there's this sort of interstitial part that is very hard to talk about and it's the coordinating function, which is how do you actually get all these pieces of interact with each other in ways that produce good results. And this is fundamentally the problem of any large, any – it's the problem with any organization. There's a cultural element to it as well and it's the kind of thing that seems like – and it's, it can be done but it requires some attention to really understand how do you weave these things together in a way where you're not just, it doesn't look like a quilt where you've just patched together a couple technology solutions, a bunch of experts, sub-predictive markets, boom, out come your forecasts.

GOLDHAMMER: It's the incentives.

[Simultaneous comments]

LOUIE: You know, the thing about what you just said that strikes me is that the probably the question that would not be asked by us of the experts, that we should ask ourselves is in any one of these kinds of new endeavors it requires leadership and a visionary to make a group of people think the impossible is possible. The absence of that or that small group of individuals who are going to go off and change the world by building any one of these systems or some hybrid version of it, it is probably highly unlikely that a group of well educated, pretty smart, good engineers and scientists can build a system that fundamentally aren't driven to [mike noise]. And that's probably the biggest risk in any of this, is to go down, to assume that you can follow a Betty Crocker cookbook recipe out of a just freshly published National Academies report and build one of these things, it probably will fail.

UNKNOWN: Yeah.

McCORMICK: To your point, software, it's always what, Version 3 that actually works?

UNKNOWN: Yeah.

McCORMICK: You've got to have the staying power to get to Version 3 and then redo it and redo it and redo it as the market changes.

GOLDHAMMER: Unless there are any other burning questions from the committee, apart from Ken –

[Simultaneous comments] [Laughter]

PAYNE: I think it's the last time the committee's together, right?

TALMAGE: Tomorrow.

Transcripts were not edited.

PAYNE: At least when your sponsor’s going to be around, right?

UNKNOWN: Yeah.

PAYNE: So with you here.

UNKNOWN: Right.

[Laughter]

PAYNE: And from all of us, from DDR&E and DIA, I'd like to thank everybody on the committee and folks who participated in the workshop.

[END OF RECORDING]

Transcripts were not edited.

Appendix E

Transcript of Breakout Sessions

GROUP 1

Group 1 Participants:

Moderator: Derek Bothereau
Richard Genik
Fred Lybrand
Jim O'Connor
Peter Schwartz
Paul Twohey
Norman Winarsky
Philip Wong
Michael Zyda
NRC Staff Member: Shannon Thomas

Team Activity: Designing a Scanning System

ZYDA: The big (loud crash) on the Internet was the Webcast and the fact that somebody had defined HTML. Those are two like boom! events. I remember this very clearly because I had a student come in my mine, Don Brutzman, and he goes, "Mike I got to show you Mosaic." I said, "Go away, Don, I'm busy."

SCHWARTZ: Mosaic was the moment.

ZYDA: And he goes, "I got to show you Mosaic." I said, "Don, why?" He goes, "Oh, you'll like it." So he showed it to me and I'm like – instantly I could – I had a use for it, which was information dissemination. Being a professor at that time I was stuffing envelopes with copies of reprints.

[chuckles]

ZYDA: All of a sudden I wasn't in the envelope stuffing business anymore, I just had to build a Web page. And I will tell you within three years – three years later I went to a conference and there were 24 papers in the conference and 23 of those papers referenced papers off my Website. And so to me, the

Internet was a big boom! So the question is – but there was a lot of long-term work there.

SCHWARTZ: One of the places that this diagram begins is decision-makers defining needs. Is a place that this system begins – Recognize we have to have a real client, namely the Department of Defense, Defense Intelligence and so on, do we – It seems to me that one of the important things we have to understand is what is this going to be used for. What do these customers actually want from this information? What they need to know, who needs to know it.

WINARSKY: These “define needs” is right at up the top. That we surely need.

ZYDA: So we should have at least one of those.

BOTHEREAU Peter, you were just posing that.

SCHWARTZ: Yeah. And it seems to me that we want to begin with a conversation of these --

O’CONNOR: Who’s paying for this and what do they want?

SCHWARTZ: We know who’s paying for it but what do they want from it? How do they interact with it? How do they get to participate, what –

[Simultaneous comments]

BOTHEREAU: Should we start answering that question now?

WINARSKY: This is what – this openness is what I'm constantly stressed – not stressed in a bad way, just stretching my mind in a good way. It isn't the needs of the funders that will make this a success, it’ll be the needs of people to consume and participate –

SCHWARTZ: A very good point.

WONG: I think that’s why I think you can almost – sort of on two streams right? You’ve got one stream which is the government side, which is their user base. And you can look at the other stream which is like the public --

SCHWARTZ: The participants.

WONG: The participants, the public. And then think about that openness. Because I don't think the government cares that their interpretation to the system is open but I think the public does.

WINARSKY: And then they interact with each other.

WONG: Well, they interact or maybe they don't.

[Simultaneous comments]

Transcripts were not edited.

SCHWARTZ: And what they want from it may be very different.

WONG: The systems may even be different.

WINARSKY: If the open system isn't any use to the government there's no point in doing it.

SCHWARTZ: That's right.

SCHWARTZ: So it's got to meet that for sure.

WONG: Yeah.

SCHWARTZ: But if it doesn't meet the needs of the participants, they don't participate.

UNKNOWN: Exactly.

SCHWARTZ: So I think the point is that there are two different sets of needs, which may not be identical.

WONG: Right.

BOTHEREA: Incentives are a huge part of our criteria so I want to bring that in.

WONG: I was thinking about interaction. I don't know if it's necessary to somebody on the government side to interact directly with somebody, I guess, on the public side or the participant side, like have a direct communication line.

WINASKY: No, no, no.

WONG: But it could be a different type of communication.

WINARSKY: That's a benefit. In other words, this open forum about IEDs will have an impact on the government side, for sure.

WONG: Right. Absolutely, yeah.

WINARSKY: Right. And, yet, you know, that's – the contribution shouldn't be driven by the government. Contributions are driven by everybody that participates whether it's Facebook++.

O'CONNOR: We've got some people here who have done more deliverables like this to government entities. What would you think would be an acceptable deliverable from a system like this and what frequency should that be handed off? Is it access to some kind of Website, is it a quarterly report that's written, what --

GENIK: I thought the frequency was it's updated when it's ready.

SCHWARTZ: Well, yes and no. My experience in this says that actually – with bureaucratic institutions you actually have to have timing and milestones in situations: a quarterly meeting, annual meeting, semi –

[Simultaneous comments]

SCHWARTZ: The report is delivered at time and the people are prepared to receive it at that time and so on. And those are forcing function. They force you to update, they force people to come to the meeting, to attend and so on.

WONG: That's actually a good point, the frequency. Or does the system need to be designed so that if somebody asks a question, which is probably more likely in terms of "Oh, this has popped up on the radar as a potential threat to the country, go ask the smart guys down – the analysts –

SCHWARTZ: So it's probably both/and.

[Simultaneous comments]

UNKNOWN: Yeah, both/and.

UNKNOWN: Yeah.

WINARSKY: That's what I wonder. My mental model has been more like a Disruptipedia, right.

SCHWARTZ: Disruptipedia, I like that. That's a good word, Disruptipedia.

[chuckles]

SCHWARTZ: The Disruptipedia system, I like that.

ZYDA: Who's checking out the URL?

WINARSKY: Then it's always there, people are always contributing.

WONG: [chuckle] That is a good one.

TWONEY: Yeah, that's great.

SCHWARTZ: Can we agree on a name? I think Norm's actually come up with a great name, Disruptipedia.

ZYDA: I like it, I'm in.

TWOHEY: There's a subtle point that we've been kind of dancing around which is that I think the assumption here is that the output was going to be the same across all times scales. And it's not clear that we even want that. So maybe what it is – I've got a question – I've got a quick question so I can get a quick approximate answer, right, versus, "Hey, I need to have a more detailed understanding of these things." Like these are very different use cases, right,

Transcripts were not edited.

they're even different ways of thinking, like kind of high-level visualizations versus starting at some point and I wander around and maybe I find something that's interesting. It doesn't have to be the same system that does both, right. It doesn't have to the same results, it doesn't even have to be the same process but just understanding that like these are very different use cases. So maybe what we should do is come up with a bucket sets of use cases and be like "Okay, here's this kind of thing. This kind of user probably wants this, this kind of user probably wants that," and we should just pick them off and figure out, "Okay, well, we'll get to some of these guys in the first one and, you know, some of the other guys, well, we won't."

SCHWARTZ: A good friend is named Michael Nacht. Michael is the Assistant Secretary of Defense from everything interesting. He does cyberspace, all the cool stuff that's not main warfare, right. He doesn't have a lot of tanks but he has programmers and all kinds of things like that, rockets, so he does all that stuff. So he asked me a question, he said, "Is there any chance in the next ten, fifteen years that somebody's going to develop a really low-cost way of getting satellites up – fast."

ZYDA: Yes.

SCHWARTZ: That's the kind of question that might come along mid-year. A new guy comes in says, "I'm looking at this stuff," and he says --

BOTHEREAU: And where would it come from and who's working on it and –

SCHWARTZ: Yeah, and how would I answer that question?

ZYDA: And you want to also invert that question because the question maybe is "When will NASA lose its capability to launch?"

SCHWARTZ: There's also that. But the question he specifically – that is not his remit. His remit was to ask the question – Because NASA doesn't launch his satellites, Air Force does. And so the question is really more is there somebody else who could do something --

WINARSKY: Who could launch –

BOTHEREAU: Pose a threat.

SCHWARTZ: A new threat, that's all.

O'CONNOR: So there's the immediate query and then there's the – If you think about all the kind of – the list, the technology list, there's also the function of list replacement or list aggregation.

SCHWARTZ: So am I wrong? Maybe I was wrong to begin with when I said it ought to be a kind of regular cycle, maybe it ought to be question driven. Maybe this whole process ought to be simply – Michael Nacht says, "I got to know does somebody have cheap launchers," and it feeds it into the system. Maybe it's purely question driven.

Transcripts were not edited.

ZYDA: So what I envision is something like Facebook where – because if you put that as a post on Facebook then all of the relevant friends that you have could comment and say, "I've got a whole study over here, here's the link." Bang.

UNKNOWN: [chuckle]

O'CONNOR: I can go post that question on Yahoo right now and in 30 minutes –

[Simultaneous comments]

O'CONNOR: -- there's no groundbreaking.

ZYDA: There's nothing to build.

UNKNOWN: That specific of a question.

WONG: Well, I think you can do that right now but how do you synthesize the information? How do you synthesize it?

SCHWARTZ: I judge the quality and so on.

WONG: Yeah, well, how do you actually – like all the stuff we're doing today, right, somebody should be sitting down and synthesizing this into a story or a recommendation, right? So I'm not too sure that piece you can really --

O'CONNOR: I mean on the existing platforms that are already there there's one level of synthesis that goes on --

ZYDA: But then what happens is in this Facebook system we end up with ratings for people. Which is I've got a name, I can click on them, I can go get the info page about them and their expertise.

SCHWARTZ: So that would – Well, now we do the details on system design. That's a good example of what we want to include. Rating systems for participants, there's that kind of system.

ZYDA: And the value – you know, and there could be a retrospective look at the value that – the posts that person has made in the past. Which is when you see a post from someone with some knowledge you can – You've got like the Netflix star system, I click four stars, "This is great," I click one star, "This guy's wrong."

TWOHEY: You've got to be really, really careful about this. When you're rating a movie you're rating a distinct action or you're rating a distinct thing, right. So you're like, okay, before me like this noun had this like overall quality thing. When you start rating a person you really --

ZYDA: No. Rating the knowledge that they're putting out there in the post, not the person.

Transcripts were not edited.

TWOHEY: Okay. All right.

ZYDA: And that will lead to overall rating of the person.

TWOHEY: But you don't want to do that. As an incentive design structure you want to be very careful about rating people

ZYDA: Sure.

TWOHEY: Because I can know a lot about computer science and I don't know a freaking thing about combinatorial biology.

ZYDA: So if you make a comment on combinatorial biology we're going to downgrade you with a low score and you deserve it.

TWOHEY: Yeah.

WINARSKY: But the way you're doing it is just what they're talking about not the individual.

ZYDA: Right, not the person, what they're talking about.

WINARSKY: But if a person has many times been rewarded with many thumbs up signs from --

ZYDA: This guy’s a sage.

WINARSKY: -- in a given area, that person then becomes an influence.

TWOHEY: Like Bernie Madoff with money?

ZYDA: No, no, like when you go and buy something on Amazon.

TWOHEY: The whole point is we're trying to find outliers, right?

WINARSKY: The unknowns, yeah.

TWOHEY: If you're trying to find outliers and you're saying, “Oh, great, I'm going to go find all the popular people.”

WINARSKY: Yeah, you're right.

TWOHEY: When do the popular kids ever like find the thing that is different, right? That’s the whole point.

TWOHEY: The whole point we're trying to solve is like not what the popular kids want. So if you go after – [chuckle]

WINARSKY: True.

Transcripts were not edited.

WINARSKY: That's really true. This kid from Afghanistan that's in a tribe is not going to necessarily be popular but he's going to come up with something particularly valuable.

UNKNOWN: Right.

BOTHEREAU: But how should our system account for some of these kind of lesser-known information sources or kind of some of these – like how do you find them? How do you find those people?

WONG: Well, I think you have to – can't you rank by relevance. I mean you have to have some system to rank relevance, I mean give certain weights to –

SCHWARTZ: Yeah, but I think the point is how do you connect in with the outliers? How do we find those people out there, how do we engage them and seduce them into the system –

TWOHEY: But what question are we answering? What question are we using these people to answer? Let's stop thinking about how we're going to go rate people and do things. Let's find like three or four different people who are going to be consuming our system and like how they want to use it. Then once we figure out what we want to give them then let's figure out how we're going to do it, right. Not like "Oh, yeah, so we're going to go exploit these guys in a village and like make them farm for beans and like it'll be great for us."

[chuckles]

[Simultaneous comments]

TWOHEY: I'm trying to say it in the most hyperbolic way possible but –

SCHWARTZ: It's good.

BOTHEREAU: We appreciate that.

GENIK: I think we should have at least one government customer and one consumer customer and then maybe --

BOTHEREAU: And I think your template – that's the guy and that's the question, right?

GENIK: Yeah.

GENIK: Consumer customer can be the movie. Give us the next plot of a Steven Spielberg short that'll be the next technology to go awry and kill a family or something.

UNKNOWN: Jim Cameron.

SCHWARTZ: James Cameron movie.

Transcripts were not edited.

BOTHEREAU: As we look back at this as kind of a general flow is there anything that we feel like we haven't talked about yet? Data feeds I feel like is – We've talked a lot about people, are there data feeds, things that are already out there that could be collected or --

ZYDA: I have a project right now funded by L&R to build an online game that does behavioral model testing. So we're actually building an entertainment game, putting it up onto the Internet, putting big servers up supporting several thousand people and we're putting various behavioral models that watch play and also interact with the people. But one of the things we're doing in that project is taking in extremes of real-time news feeds. So we're pulling RSS feeds off of CNN.com, off of the BBC, off of economic sites, and plugging that into the world that's in the game such that it impacts the game play of the autonomous characters.

SCHWARTZ: Oh, the autonomous characters, not the human characters?

ZYDA: Well, and human characters by – So, for example, if we see a terrorist bombing coming across the RSS feed, the autonomous characters today are very nervous and upset and angry whereas if they don't see that they calm down over time --

LYBRAND: That's pretty cool.

ZYDA: -- and then they interact with different people. So we're building this, we're at the end of nine months right now, it's going really well. But the whole idea of news feeds is the big deal because we're going to have this interact in interesting and experimental ways with people.

SCHWARTZ: So you could answer a question for me.

ZYDA: Yeah.

SCHWARTZ: When I think about these data feeds – do I have to necessarily have in a sense a human being reading the data, understanding it, or are there interpretive models for taking it and further digesting it before it gets to me as a human being?

BOTHEREAU: An automated model.

SCHWARTZ: Yeah.

ZYDA: Yeah. Yes, you can do automated stuff.

TWOHEY: Everyone's already gone over this. There's this intelligence apparatus right now for dealing with the things that we know about, right. We already know about RSS feeds. They're already funding people to deal with this, right. Like we don't need to worry – I mean the whole point is coming with the system, it's going to come with things that we don't know about, right. So I think that –

Transcripts were not edited.

SCHWARTZ: Well, no, no, no, no, no. I think that's not quite right. In other words, the way in which we come up with things which we do not know about may not be out of anomalous data points of themselves but of the interactions of many different things together, the pattern of things which in and of themselves may not be sufficient.

BOTHEREAU: The correlations not the events.

[Simultaneous comments]

TWOHEY: But I guess what I was – so there's – the take that I'd like to put out there is this should be people driven because there's going – Like for the data to be useful, for people to act on it, for them to disrupt they're going to find it. The axiom that we should us is that they're going to find it before we know about it and they're going to use it and act on it before we know about it. If you want to have an algorithmic solution for finding sets, you want to have a big Google, right, so you want to have a disruption rank or whatever it is –

SCHWARTZ: But isn't it both?

TWOHEY: It's a totally different way of looking at it. Like the algorithmic things that you can do for these kinds of minings, they all assume that people have already built up and structured the data in some way, right? Like the reason page rank works is because everybody on the Internet has a local incentive to point to the thing that they care about and then Google goes and scrapes it and like puts it together. But if what you're trying to do is find the nascent things before they've established a pattern, right – So you might have this – you're like building some cloud of possible futures to go look at and maybe head off legislatively or politically or whatever. Then like by definition these things won't have been built, right?

SCHWARTZ: But it's a both/and. You're right in some sense but let's just take a real example. I spend a lot of time thinking about the future of social dynamics in places like the Middle East. So not surprisingly I look at a lot of demographic data, cultural data and so on. Well, in the end, yes, I'm looking for myself, I'm the interpretive engine but before it got to me there were a whole bunch of people and a lot of data that went into massaging the demographic numbers and I'm looking at a bunch of different demographic projections and so on. So there's an elaborate architecture underneath the human interpretation, some of which is purely mechanical, some of which is simply the integration of a whole bunch of demographic data. So it's not an either/or, it's a both/and. In the end it is a human interpretation, I fully agree, but along the way there can be digestion of data that is purely mechanical. That's all I'm saying.

TWOHEY: But it just sounds like what you're asking for is better tools to do your existing job. It turns out like the data analysis tools that you have, that they're not as good, they don't have as many feeds. You'd like them to be able to do better, you'd like to do all this kind of analyses but that's a different question. That's like "Hey, I've got a pretty good handle on what I want, I've got these six features, can you software tools people like go please make my data analysis things not stink? I'll pay you some money and like make it happen,” right? I don't know, I think this is a different question entirely.

SCHWARTZ: What’s the different question?

TWOHEY: The different question is I'm – what – where do we get the data and the leads to start looking at things that we don't even know about yet that should be the problem?

WONG: Right. I wanted to make on that which is right now – I always get the sense that right now we're thinking about specking out a Website which, you know – for better or for worse, that’s the impression I get, that we're going to create a Website and we're going to have this exchange of information similar to a Facebook. But the reality of it is isn't the information already out there? People are just already using other sites and doing the things that we kind of want to observe?

TWOHEY: A lot of it, probably.

WONG: Right. So wouldn't a better solution [be] not to actually create – for us to interface with the end user but for other people who are already – the end user who’s already interfacing with whatever application out there, for those people to look and see what they're doing on those other applications.

[Simultaneous comments]

SCHWARTZ: Can you give us an example?

WINARSKY: Mining that information.

WONG: Yeah, mining that information.

[Simultaneous comments]

WONG: In an ideal world if you could create a search spider --

WONG: -- that could go out and collect information from every single Website out there that you're interested in and pull that information and then process it, wouldn't that be as useful as having your own site and being able to process that information?

LYBRAND: Produce widgets for other people to put on their sites. [chuckle]

ZYDA: There was a really cool search system that one of my former students has been trying to raise funding on and I liked it a whole lot. I'll describe it to you because it’s cool. I don't think he'll get upset. You're a scientist and you write a technical paper in an area and what you'd like to know is “Did I get all of the prior literature right and is there anybody else working in this area?” You take your PDF and you drop it onto the search engine and it goes out and it reads the whole document and finds people who are working in

Transcripts were not edited.

your area and it tells you those links and it also will tell you in the future when new papers appear on the Net, stuff related to what you're doing.

UNKNOWN: So it’s persistent.

ZYDA: It’s persistent. It’s –

SCHWARTZ: That’s cool.

ZYDA: And it’s very cool. He’s been trying to raise money, he’s a pretty hot guy so I think he'll get the money. But this is, I think, kind of a core piece of what we're all talking about. It’s different than Google because Google today is what’s there now or what was there when we did our spidering. Whereas I'd love it to tell me --

TWOHEY: No, no. Have you ever seen Google Alerts?

ZYDA: Oh, yes, I use Google Alerts but what you really want is – Google Alerts works on just a couple of keywords, this is the whole paper, which is – you know, you're interested in this – the whole thing is the search.

WINARSKY: The thing that bothers me about this – I mean it doesn't bother me because this is a right direction. So crawling and mining information from other people’s sites doesn't require this very unlikely event that you'll have a very popular site, right?

SCHWARTZ: Right. Exactly.

WINARSKY: One in a million get that way. But you do need also these active contributions too. Not just mining other people’s ideas - Because if you have a question like “When will it be low-cost capable to launch your own small satellite?” I'm not sure mining is going to get you that information as much as somebody responding to the question. Literally, you know. I see that question and I'm motivated to answer it.

SCHWARTZ: Both/and.

WONG: But do you actually have to host that site to do that or can you use somebody else’s site to do that?

SCHWARTZ: That’s the question you're asking.

WINARSKY: Yeah.

UNKNOWN: Right. I'm just thinking if you were a guerilla right and you don't have a lot of resources you would want to use other people’s assets, right?

WINARSKY: Right.

WONG: And that’s what we would want to do, I would assume.

WINARSKY: Right.

SCHWARTZ: That’s an interesting way to think about it. If you were the bad guys how would you design this system? [chuckle]

WINARSKY: Right.

BOTHEREAU: You'd find out about our technology –

WINARSKY: So as long as you can ask proactive responses to questions and motivate people to answer?

WONG: But companies do that all the time. You have these community sites that people participate in, companies regularly have their own contributors. They throw up a product idea and they see how the community reacts to it.

ZYDA: Every single online game that gets released has a fan site where – it’s basically the community site for the game which is bug fix reports and requests for new missions and levels and content. You get incredible smart folks. I think in America’s Army we created a site – we had 150,000 people providing us feedback. We actually selected our several hundred beta testers from the best responders.

TWOHEY: There’s a company called Wolfire Games. They're actually funding the development of their game by doing this. So they have their fans. They haven’t even released their game yet and they start talking about the process of the thing they're building. So they release like little betas that you get to download if you’ve paid into the system. So they're actually totally funding --

ZYDA: That’s pretty clever.

SCHWARTZ: [chuckle]

WINARSKY: That’s great.

TWOHEY: Well, because the guy who did it, I guess he made some cult game a while ago so like they believe in this dude and they have this messianic following of this guy and it’s totally working for them.

GENIK: Going along the lines of somebody asking a question. I don't know if you can address something as abstract as “When will satellite launching be cheap?” The high-level person feeding the input, the customer can ask that question but then that has to be interpreted into “How are we going to do it? Maybe we can make a carbon fiber elevator for example. So you would want to go out on the Web and find people who know stuff about carbon fibers, who know stuff about launching satellites and you'd get the overlap there and that’s something that I don't think exists right now.

TWOHEY: Don't you just care that it –

GENIK: I mean.

TWOHEY: satellite could be cheap? I mean it's like I interpreted the goal of this project is to come up with a thing that like "Look, there's this future that's coming, maybe not fifteen years away, where launching a satellite isn't that expensive."

WINARSKY: Right.

TWOHEY: Right. And that's it. At that point we're done because then it's somebody else's problem to go like "Look at this" and analyze it in detail and now have the experts study it and figure out – Because now that we've discovered this could happen like great. Now we've hit upon it, the mission of this thing is done. Now we're trying to come up with the next crazy thing where it turns out like I can rewrite my genome –

WINARSKY: But don't you need – For credibility purposes, for people who are customers to take that seriously aren't they going to say, "That's great. Did you read that in a Superman cartoon book or do you have evidence that makes me believe strongly in this?"

LYBRAND: Maybe a system like that is part of a regular report that says, "Okay, gosh, we're kind of persistently looking at all these things that could disrupt. Something like low-cost satellites has a low priority in our last bi-annual update. This time instead of it being a 30-year horizon, it's a 10-year horizon." And you balance a system like that that just has kind of a regular survey with a query-based system like what Peter's friend at SecDef would want.

BOTHEREAU: One of the things we heard earlier this morning about – what Gilman was saying about what makes a good forecast, was around being able to kind of describe the impact of something like that. What I heard you just say is after you kind of describe the impact there could be kind of a hand-off stage to another entity that would do the tracking or something like that.

GENIK: Wouldn't we want to know that in advance though?

BOTHEREAU: Pardon?

GENIK: We'd want to know that in advance. We'd want to say, "Okay, we know that low-cost satellites are happening, get me a group of experts together and go tell me what's going to happen once we have low-cost satellites so that we'll be prepared when it happens.

BOTHEREAU: This is starting to get in kind of to the bottom of this graphic which is allocate resources. So once you seem to have a forecast that's emerging, how do you actually allocate either people or computer systems to track it and actually start to figure out the details of what's going on? That's something we'll want to think about when we do the actual?

Transcripts were not edited.

WONG: Are we saying that that is the ultimate output? Like once we've identified that as the output –

BROTHEREA: I'm asking. That’s my thought I'm deliberately like going on one side so --

WONG: Well, there's the next layer of the onion that’s --

O’CONNOR: I think the next layer is the report that would come from the experts might be the output.

WINARSKY: Right.

TWOHEY: Or a set of data points that you know you need to be tracking, certain threshold levels.

WONG: Yeah.

BOTHEREAU: So when – I think with the satellite that’s kind of a very discrete example. If something happens there there’s going to be a press release or you're going to see something flying up in the air with cloudier issues – picking up chatter on message boards, etc.

WONG: Well, this is before the press release. This is the idea that – using the launching – an inexpensive way to launch satellites today would be the idea that somebody is gestating somewhere around the Web. That’s what you would want to identify as an output is that.

TWOHEY: And I think – I don't know, I think it’s pretty clear to everybody – at least to me that like this is going to happen.

WONG: Right. It’s going to happen. Yeah.

TWOHEY: Pretty soon, right?

SCHWARTZ: What?

TWOHEY: Cheap satellite launches.

SCHWARTZ: It is. It’s clearly.

TWOHEY: It’s clearly going to happen.

GENIK: So somebody should be looking at –

[Simultaneous comments]

ZYDA: Someone staring up at the sky.

TWOHEY: I mean it’s already happening, right. Like you already had space experts working on it.

O'CONNOR: Well, it depends on what's cheap.

LYBRAND: Right.

TWOHEY: The question is more like "What – "=Like people have been talking about like "Is the cost of orbit going to go down?" This is a question you see, a persistent query, right. I think as long as I've been alive and reading magazines, right, they've always said like "Oh, it's getting cheaper, it's getting cheaper, it's getting cheaper." There's micro-satellites, you know. So the question is more like what's something that we're not thinking of yet? Like we're a bunch of white dudes around a table --

ZYDA: We might not be able to launch satellites –

[Simultaneous comments]

WONG: And one Asian guy. And one Asian guy.

[chuckles]

ZYDA: We might not be able to launch satellites anymore because we have so much debris in space.

TWOHEY: Yeah. Or maybe it's like "Oh, well, you know, this ocean acidification is going to like totally --

WINARSKY: This what?

TWOHEY: Ocean acidification totally changes the global carbon cycle.

WINARSKY: Oh, yeah.

TWOHEY: Like makes fisheries die off, cause like massive kinds of climate change. So this kind of things happens, right, and entire economies will collapse and this will be a very disruptive – If it happens, right, and people are postulating that there's some tipping point, right. So maybe the first time you see some paper in some like academic conference about this someone's like "Oh, well, this kind of matters. Maybe I should –" Maybe you want to know about this and just – like no one's sure of what's going to happen but you want to track it a bit more because –

WINARSKY: Yeah. So there's two ways to do it. One is a narrative that says – You know an event might happen and it would be a market disruption and you just predict what would make that happen. And then sometimes you follow a technology trend. Like in this case a global warming, carbon dioxide in the air, therefore you read about this ocean stuff. Or another example I was just thinking about – I gave a talk a few years ago on video deception and the ability for processing power in real time to insert or delete objects into video.

TWOHEY: It's crazy what you can do.

Transcripts were not edited.

WINARSKY: So now all of a sudden you could put – somebody who was in a dry country, a glass of wine in his hand as he's talking on TV and that person's reputation is destroyed, okay. So that's a surprise impact that you could never have imagined until you watched the technology curve, right?

GENIK: Going along with what Fred said, I would want our system – and I've got a, hopefully, short example here. That is let's say that DIA is looking at detecting deception and they want a system that detects deception using cheap things like a polygraph 100% of the time. Now, of course, we all know it doesn't work. We've done 80 years of work on it and it doesn't work because from these polygraph measurements you can't tell – What you measure is autonomic excitation caused by anxiousness. Now is the anxiousness caused by the person lying or is the anxiousness caused by the person -

WINARSKY: Situation.

GENIK: -- just being – situational anxiousness. So that can be sitting down there and persistent. Some paper comes up in a journal on depression that says, "Hey, look, you know when people who have a clinical depression, if you give them a situation which causes anxiousness they have a different autonomic response that changes based upon whether or not they have this disease or not." So maybe that can give you a clue into getting rid of the --

WINARSKY: Autonomic response.

GENIK: When that paper's published I don't want a flag to come up and say, "Hey, go back and look at all the –"

WINARSKY: Manic depressives.

GENIK: Well, "Go back and look at the lie detector stuff because all of a sudden there's some new input there.

WINARSKY: Either that or recruit the spies out of the category of people.

GENIK: Yeah.

[chuckles]

BOTHEREAU: That's kind of the persistence point though is not reformulating going back.

GENIK: Yeah. It should sit there and it should keep scanning and if something – now if a question comes up that needed to be answered before then it should alert you that an answer might be out there and at least you've got to get your experts back together again because you can't have the same guys working on everything over and over and over again.

Transcripts were not edited.

BOTHEREAU: So how often would something like that? I mean obviously you can't predict when there’s going to be a new input that is a game changer but if we're designing a system that needs to have regular intervals or milestones.

GENIK: Well, it doesn't have to be milliseconds and it shouldn't be years.

BOTHEREAU: Quite a range.

[chuckles]

ZYDA: But it might be years. It might be decades.

GENIK: Oh, for the thing to happen but to sift through the information?

ZYDA: No, no. But by the time it’s gone to the big jump. The big jump is going to happen because a couple things crash together like Mosaic with HTML.

GENIK: Right.

ZYDA: But the underlying technologies were there quite a long time, years, decades. So I don't think – had you gone off and built this system and you had to look at the rich work being done on the Internet, you wouldn't have ever predicted the exponential growth of the Internet. And, in fact, even when Mosaic came out and HTML happened I thought it was really cool just for my neural thought of professor publications. And the fact that Amazon then got created and all of a sudden you could get any book you wanted, that was kind of cool too. It just was the right time. But to try and build a system that could have recognized that that was going to happen ahead of time – not possible, I don't think.

GENIK: Well, this is where we're having – you're 100% correct but that’s a slightly different system. That’s one that’s trying to predict something that we don't know about and looking into the undefined versus this where we have a customer that’s trying to answer a question that gave us some input, the guy that gave us the money. You can't really say – the only thing it can do is say, “Well, I'm going to go predict what the unknown is.”

LYBRAND: Right.

TWOHEY: But it needs to be part of it though.

GENIK: Yes, yes, yes. It definitely has to --

TWOHEY: Have you guys ever read *Rainbow’s End*?

SCHWARTZ: Brilliant. An absolutely spectacular book.

WINARSKY: Yeah. Kind of –

TWOHEY: The whole premise of this book is that like people are going to – Your augmented cognition thing reminded me. The premise of this book is that like people are going to go – in the not too distant future that there’s going to be these like little helpers that go around that help you do data analysis. The number one skill that matters is data analysis. So like your ability to pull in data, analyze data is like what distinguishes you as a human being from other human beings. Part of what I hear is just like “Man, my data analysis tools stink.” Like you want better things for looking at demographic data. You want to look at papers, you want to be able to pull these things in, run these kind of queries, you want just a richer like set of things across all data that’s publicly available and right now like it’s not enough. So it sounds like what you want to do is you want to fund a post-Google search engine strategy, right? Like you want to have a richer, deeper set of things and you want people to innovate on this and you're not even quite sure what you want. So like “Let’s make it happen.” That’s totally than like “Hey, I don't know what’s going to happen. Maybe you could tell me a movie plot.” So like we could –

SCHWARTZ: But I want both/and. I want a system in which I can interact as a human being, pose queries and observe patterns and be surprised. And I also want a system that is sufficiently broad and rich that is gathering data and presenting it to me even when I'm not asking. I'm the sort of person that read encyclopedias, right, because I don't know what I'm going to find, and almanacs because I don't know what I'm going to find.

TWOHEY: You must have loved Stumble Upon?

SCHWARTZ: Yes. But the point is that you don't always know what the query is. The system has to be able to do both. It has to accept queries on the one hand – what’s the low-cost launch strategy, and what am I not thinking about that I ought to be thinking about.

GENIK: I think the other thing that we haven’t talked about yet is – we've been kind of focusing on the Web app idea and we've kind of forgotten about the idea of using a Delphic method. Maybe we also want to have a system where we collect data from some group like the Jason Group. You fund to send out to a set of conferences or have workshops that try and collect information at that level and bring it in and then discuss it amongst themselves and produce reports.

WINARSKY: There’s got to be multiple feeds. We can't just have one feed.

GENIK: Right.

UNKNOWN: Oh, yeah.

UNKNOWN: Right.

GENIK: Right, right. This has a different feed.

WINARSKY: Gartner could be a feed, right? You know. Wikipedia could be a feed.

[Simultaneous comments]

Transcripts were not edited.

SCHWARTZ: Something we should actually learn from. I'm on the board of what's called the Research Innovation and Enterprise Council of Singapore, it's chaired by the prime minister and a bunch of cabinet members and a bunch of outsiders – Clay Christensen, the head of R&D of Siemens, Novartis, Dupont, the president of Stanford --

GENIK: Is Judith what's-her-name on there? Judith Swain?

SCHWARTZ: No. But underneath us there are about four hundred scientists organized in about thirty or forty different committees and different disciplines, different arenas and so on and they're doing a whole bunch of stuff feeding us and then we're taking it and then finally making decisions about program allocation.

ZYDA: So they're kind of doing what I was talking about.

SCHWARTZ: A billion dollars here, a billion dollars there and so on.

GENIK: Next thing you know it's real money.

SCHWARTZ: Well, it's twelve billion a year. It's already real money.

[chuckles]

ZYDA: That's Singapore dollars though, right?

SCHWARTZ: Twelve billion Sing. Yeah, okay, so that's only about eight billion U.S.

TWOHEY: I'll take that. You want to give it to me?

SCHWARTZ: You'll take that. It's bigger than NSF.

[Simultaneous comments]

O'CONNOR: The fx rate is in their favor, right

SCHWARTZ: Yeah, right now. My only point is that it is a fairly elaborate system of human beings on the one hand massaging and feeding. And it's quite large scale, I mean it's hundreds of scientists in these kind of panels and Delphi groups. Paul Saffo is on one of them.

ZYDA: Again, this is the mechanical turf, which is humans feed – intelligence feeding upper-level stuff.

SCHWARTZ: Yeah, that's right. Exactly.

TWOHEY: It was interesting. When I told a bunch of friends that I was coming to this thing and they're like "Oh, wow." So I asked a bunch of grad student friends like what they thought was going to go change the world. It turns out if I just

Transcripts were not edited.

asked them like “Hey, what do you think’s going to be like the coolest thing that’s going to happen?” I got a lot of really interesting responses.

SCHWARTZ: Like?

TWOHEY: And then – hold on. But then I asked a different question, I said, “Can you tell me about disruptive – “I asked people “Can you tell me about the things that are going to be disruptive technology?” And they all kind of looked at me like I was on Mars, right.

ZYDA: What planet are you from?

TWOHEY: Yeah.

ZYDA: It’s a bad term.

TWOHEY: It’s like “What?” So the whole way you frame the question really matters. So all my friends, the two themes were robots – they think that like small robots with intelligence are go around and they're going to do lots of things --

LYBRAND: Remotely

[Simultaneous comments]

SCHWARTZ: Or spybots

GENIK: I've got a video of that with me.

TWOHEY: Then the one they thought was the sequencing technology in genome

SCHWARTZ: Genome sequencing.

TWOHEY: Like the massive – like the combination between like massive gene sequencing, synthetic biology and computational stuff, that it’s going to totally change like the way we looked at medicine and the building blocks to do DNA.

WINARSKY: Yeah, so –

TWOHEY: I got that just by asking people and I think that there’s actually a lot of value in asking – So the NSF, right, they have a bunch of money and so they fund a bunch of graduate students, right. So if you look at the people that are actually implementing most of the technological change, right, not IEDs but like if you look at technology-driven disruption, right, it’s almost always coming out of an American university funded by U.S. taxpayer dollars. So as long as you're going that you might as well ask the graduate students every semester to put in three paragraphs: What’s the coolest thing that’s happening in your area – like your direct area? What’s the coolest thing that’s happening in your field? And what’s the coolest thing that’s

Transcripts were not edited.

happening in science, right. Just like literally three paragraphs, less than five hundred words each. How many people do we fund, right? We probably fund –

SCHWARTZ: Make it a requirement of every NSF grant. [chuckle]

[chuckles]

O'CONNOR: Log in to Disruptipedia.

[laughter]

SCHWARTZ: And you don't get your check until you've cleared off the Disruptipedia.

O'CONNOR: Fill out your security number with your hard-copy submitted application.

[Simultaneous comments]

ZYDA: And the grad students that did the work are from China.

SCHWARTZ: I think your point's well taken. I think it's a good idea.

[Simultaneous comments]

TWOHEY: What I mean is if you want to do some kind of Delphic method I think that you're going to get – So I was thinking – one of the questions I wrote down was – there's this question of experts versus crowd, right. How are experts made? How did you get to be an expert? Well, usually it's passion plus time. So you're sitting there just like doing…

[Simultaneous comments]

TWOHEY: But if you're really into like movies or you're really into biology. Like my friends that are in genomeology, they've been looking at slides since they were like seven. That's the kind of people that you want to be answering these questions. So maybe you should just – Because we already have – If you want an expert in biology, right, you call somebody up and you've already got it.

WINARSKY: By the way, you don't always call a graduate student up. It could be these crazy people that are not in …

[Simultaneous comments]

SCHWARTZ: But that's an "and" it's not an "or."

TWOHEY: I'm not saying you should only do this.

WINARSKY: Yeah. Yeah.

SCHWARTZ: But I think it – one of the ideas we had early on was to create a system that basically looked at what people were doing for their Ph.D. dissertations and say what are they making personal commitments to by the choices that they make in their lives as a way of mapping potential disruption. We found that actually difficult to try and pull off but it basically gets at the same point. I think it is (a) an interesting source when you have the graduate students who are right at the leading edge of each of the disciplines.

WINARSKY: But here's the problem. The things that we're looking for are the 1% or one-tenth of 1% events which most great universities would look at somebody who might try and want to do some – who was really excited by some cool idea like cold fusion or something like that and say, "What are you thinking of writing a dissertation on?"

O'CONNOR: But I think one thing to take notice of is that if you have these grad students who are these experts, self-declared experts, in one place that is kind of a honey pot for those fringe people.

WINARSKY: Right.

O'CONNOR: They'll be attracted to that community. But it is figuring out, you know –

TWOHEY: Then you can data mine to your heart's content with the Yahoo submit to the…

WINARSKY: But imagine if I'm in the MBA school and I said –

TWOHEY: Well, you're not going to [..?..]

WINARSKY: -- two years ago and I said, "I'd like to write a master's thesis on what would happen if subprime mortgage--"Well, that isn't so strange, is it? What would happen if --

O'CONNOR: It was four years ago.

[Simultaneous comments]

SCHWARTZ: If one of the big investment houses vanished in a weekend.

WINARSKY: Yeah.

[chuckles]

WINARSKY: You might not get your degree is what I'm getting at.

SCHWARTZ: That can't happen.

[chuckles]

[Simultaneous comments]

Transcripts were not edited.

TWOHEY: So there's this question of like what are the axioms of the system. You wouldn't get your degree, so maybe there's some value in just having explicit – making explicit what the assumptions are.

WINARSKY: Right.

TWOHEY: Then you go play what-if games every quarter with your experts. Just "What if this thing didn't hold?" My mechanical engineering friends say that like when they're trying to build something they go and they play this game about like what-if. What if they could just like kind of disable one of the laws of thermodynamics or –

[Simultaneous comments]

SCHWARTZ: Aren't we saying – this goes back to, I think, your point that you began with, Rich, of a system of systems. A question I have is this. We're identifying a number of different strategies for surfacing things, for judging them and so on, whether it is a Delphi-like approach, whether it's talk to the graduate students, whether it's looking at Ph.D. dissertation, whatever it may be. So I think what we want is a variety of such strategies and then a meta strategy for learning from those so that they get better. We drop things that don't work, we add things that do work and that we are building a kind of learning dynamic over time that says, "The first pass through this, Version 1, we tried five different strategies and four of the five worked but three didn't yield must useful –" or "One didn't yield much useful. We're going to keep four and we're going to add another one in the next generation," and so on. Is that the kind of model that we have?

WINARSKY: Yeah.

UNKNOWN: Yeah.

UNKNOWN: Yeah.

LYBRAND: Well, I have a proposal – let's be the first group to go out and play with the table.

UNKNOWN: Right.

UNKNOWN: Right.

LYBRAND: I mean I think everybody has the one or two points that they really care about.

[Simultaneous comments]

WONG: Just before we go though, we talked about the technology – well, we talked about the sort of idea of PhDs and graduate students and thinking about the cutting edge technology, right, and I just wanted to sort of bring us back a little bit to, well, actually, use cases, right, and to the guy again in sub-

Sahara Africa, right, and he's not necessarily using the latest nanotube technology –

SCHWARTZ: A very good point, right.

WONG: That's the use case that I'm most interested in.

WINARSKY: Yeah.

SCHWARTZ: So how do we get at that one?

WONG: Huh?

SCHWARTZ: How do we get at him?

ZYDA: Buy him an iPhone.

WINARSKY: You start from his –

SCHWARTZ: What?

ZYDA: Buy him an iPhone.

TALMAGE: Actually, they're already on cell phone technology there. They didn't put landlines in, they went straight to cell.

WINARSKY: You start from his need. I want one person to kill a thousand – or

SCHWARTZ: But how do you find out what kind of things that they – How do you find the guy who's figuring out how to put an IED together?

[Simultaneous comments]

UNKNOWN: That could be some of the global --

TWOHEY: The question's actually irrelevant, right, because like we now know that IEDs exist. That's a totally separate question

[Simultaneous comments]

O'CONNOR: They did this before. I mean there were booby traps before and re-labeling them

TWOHEY: But what I mean is after the first month of IED attacks in Iraq like this whole question of disruptive technology was moot from like our perspective here because at that point in time it's a disruption that the military's already noticed it happening and …

SCHWARTZ: I'm sorry. I have to disagree. If before the invasion of Iraq in 2003 – if a year and a half before they said, "You know, one of the biggest threats we're going to face is IEDs and here's why." "Well, you know, the vehicles we're

Transcripts were not edited.

sending over are wrong, the armor we're sending over, body armor, is wrong and our guys aren't trained and we don't have detectors. So what we really need is redesign of our vehicles before we go in, we need some new detectors and we need some new training.” That did not happen and a whole lot of people died as a result of that.

WONG: Right.

SCHWARTZ: So it is not accurate to say this is an old technology. It wasn’t in the perception.

[Simultaneous comments]

TWOHEY: No, no, no, what I said was different.

ZYDA: There's some social things in the military that are pretty critical that you're going to have a hard time getting around because if you – In the military there are two different camps that do this job. There’s an analysis community and there’s a modeling and simulation community and, you realize, those are two completely separate communities. And if you go to the analysis community, they’re ops research guys, they’ve got some mathematical modeling behind and they love to do big statistical runs on big engagements. They don't do much in the way of thinking of surprise, they don't do much of anything in thinking “How do we go off and look at the behavioral end of things?” So I think that’s going to be the – that’s, to me, one of the fundamentals that you'll have. So if you were going to go and improve the analytical capability of the military you would actually smash those two communities together and cross-train them and provide a tool that could get them out of their comfort with their current toolset.

BOTHEREAU: So to Fred’s suggestion, I think we probably should go over there and kind of start laying it out, okay. Is everybody okay with that?

[relocate to project table]

[resume conversation at table]

TWOHEY: Like if you look at disruptive technology in the Silicon Valley area it’s – VC funds have a ten-year time horizon, right, and they have a 70% failure rate, like 10% like massive success rate. It’s only asset class. Where if you bought into the average of the asset class you'd lose money.

WINARSKY: Exactly.

O’CONNOR: For venture capital.

TWOHEY: Yeah, venture capital. So you need to be aware of the fact that like what we're trying to do is we're playing venture capital on ideas.

WINARSKY: Right. Very clever.

Transcripts were not edited.

TWOHEY: Like just the model we have for success and how you evaluate these things – we need to have – Whatever system you put in place, right, you can't say "Oh, it didn't find this thing in this one year," right, or "It didn't find this one disruptive technology so let's chuck it right away." Like you need to have a – The cool thing about government, the only cool thing about government is it has enough money and time and patience to have a long time horizon, right. That is the key resource

LYBRAND: Now you sound like a college endowment officer, that's – it's – yeah, yeah, yeah.

WINARSKY: Uhhhhhhh.

TWOHEY: But what I mean is like it's the key thing, right. Because you can be like "Okay, I can wait, right, I can be patient." So like this is cool, right, so this lets you --

GENIK: Well, it depends what part of the government you're talking about.

TWOHEY: But I mean as long as you're not spending ridiculous sums of money doing it – like if over ten years it only costs you a million bucks, right, and like the upside is huge, right, then it's okay. Right. Right.

WINARSKY: So your point is --

GENIK: That has to be leveraged somehow because you're not going to get – over ten years if you got one person and $100,000, you're just paying his salary. It's got to be leveraged with some other kind of funds.

TWOHEY: Of course. Of course, right. But I guess what I'm saying is like it's okay.

GENIK: I don't mean to shoot down your idea.

TWOHEY: No, no, no. No, but I mean like it's okay, right, like if we come up with a portfolio of really leveraged ideas and it's like "Oh, yeah, so most of these things will fail and we're okay with it," and like some politician doesn't make his re-election bid by like taking your thing and like gunning for it and knocking it down. [chuckle]

GENIK: Like DSSC.

TWOHEY: Well, there's some prediction market, right, for terrorist things and…

WINARSKY: Right.

LYBRAND: Yeah, yeah. We had the people who did it come in and spoke to us --

WINARSKY: I wasn't there then.

LYBRAND: -- before we got the smart guys involved.

Transcripts were not edited.

WINARSKY: [chuckle]

TWOHEY: What I mean is like somebody got re-elected because they're like “Oh, this is a really stupid thing.

GENIK: Yeah, because I shot this program down because – not because it was necessarily bad but I can show that it was bad to –

SCHWARTZ: But this might be input, that might be output.

[Simultaneous comments]

TWOHEY: People far more intelligent and like with much better social skills than myself [chuckle] need to be involved in selling --

GENIK: Yeah, don't put the scientists in front of --

LYBRAND: That’s all right. The guy who has to deal with manufacturing problems, I always start at the end.

SCHWARTZ: Do we want to assign any meaning to the geometry?

TWOHEY: Go for it.

LYBRAND: I just started writing.

THOMAS: So rectangles are output – or at least --

WINARSKY: Rectangles are output –

O’CONNOR: What are they normally?

WINARSKY: Triangles are --

THOMAS: Whatever you want it to be.

[Simultaneous comments]

TWOHEY: So what do you consider if you're a customer?

LYBRAND: Well, I would either come up and say, “Where’s my regular report that I want every X.” I don't know what time period, you tell me. Or I would say, “Here’s my question. Microstats, tell me more. What’s the –“

WONG: I was just thinking about this. The idea of having a regular report puts us back in the paradigm of like what we've done historically. You expect like “Well, this threat is not going to come up for another two years.” Well, guess what, things don't necessarily take two years or our prediction timeframe might not be two years. What if it comes up a year in advance, what happens if it comes up in six months? Right?

Transcripts were not edited.

GENIK: No, no, you're right. You're right.

LYBRAND: Based on the sponsor feedback I just don't see how they --

THOMAS: Well, if you are the analysts --

GENIK: Well, without at least a yearly conference or something.

THOMAS: …team that's going to work it and then you have the customers who are higher ups. The analysts themselves might want to bring them a quarterly update.

LYBRAND: This might not be external.

[Simultaneous comments]

SCHWARTZ: So lets have three things here. Output #1 is query response. I got a question, I ask the system, I get a response. Second is analyst-driven output. I see something interesting going on somewhere in the system, we've surfaced something. “Customer, you didn't ask and we're not at a regular report interval but a thing has come up you need to know about.” So analyst-driven output. And then regular systematic output because the truth is that bureaucratic systems need that.

GENIK So that’s a third, yeah.

SCHWARTZ: That’s a third.

[Simultaneous comments]

WINARSKY: I'm struggling with this regular stuff.

SCHWARTZ: It won't survive. It won't endure.

[Simultaneous comments]

WINARSKY: Regular reports. Let me tell you what my problem is.

[Simultaneous comments]

GENIK: It might be as needed sometimes and it never happens.

WINARSKY: My problem is we're talking about disruptive events that are unpredictable.

SCHWARTZ: Right.

[Simultaneous comments]

[microphone noise]

SCHWARTZ: I'm saying three different forms of output.

Transcripts were not edited.

WINARSKY: Okay.

SCHWARTZ: One is driven by the event, okay. So I discover something interesting in the system and you're my customer. I call you up, "Norm, hey listen, we found something interesting you need to know about." That's one. That takes care of the case that you're just talking about.

GENIK: That's analyst driven.

SCHWARTZ: That's analyst driven.

WINARSKY: Can we follow that a little bit?

SCHWARTZ: Okay.

WINARSKY: So would somebody – taking the previous conversation, somebody said, "I just saw Mosaic working on the Web.

SCHWARTZ: Right. Good example.

WINARSKY: I mean working on ….

SCHWARTZ: I just visited University of Illinois and I just saw the first version of a browser and I think this is a really big thing.

[Simultaneous comments]

WINARSKY: I think this is a big thing, okay. So this is sort of a scanning, proactive surfacing of a big thing which has low probability of having happened, some surprise event.

SCHWARTZ: Correct. That this is really going to take off, a network effect could happen.

WINARSKY: So that's like you saw it. Then there's the predicting of those things that might happen. Predicting Mosaic is another whole level of –

TWOHEY: Because you look at the Xanadu, right, or whatever project – There were a couple of people that were trying to make hypertext systems before Mosaic, right, and they –

WINARSKY: Right.

TWOHEY: And they – "How do I know about this? It's like they didn't – like they didn't ….

SCHWARTZ: We didn't have the means to do Xanadu when Ted Nelson first came up with it. Now we've done it! It's not exactly Xanadu but it's close.

BOTHEREAU: Have we decided on what we want the shapes to signify?

SCHWARTZ: No, we have not.

[Simultaneous comments]

LYBRAND: I'm still running with squares as output. Squares I mean rectangles.

[Simultaneous comments]

SCHWARTZ: Analysis and decision.

WINARSKY: Analysis and decision.

[Simultaneous comments]

SCHWARTZ: These are outputs, inputs, analysis and decisions.

TWONEY: Where are we starting? Are we starting –

SCHWARTZ: Well, we started here with outputs.

[Simultaneous comments]

WINARSKY: This is the inputs at that side of the table.

SCHWARTZ: Left hand is input, this is output.

[Simultaneous comments]

LYBRAND: So our manufacturing guy looked around and said, "You start with what you want out of the system." So that's my bias.

[Simultaneous comments]

SCHWARTZ: And we've got three classes of outputs now.

[Simultaneous comments]

SCHWARTZ: We've got output that is query driven, output that's regular system driven, and output that is analyst driven.

[Simultaneous comments]

LYBRAND: And I'll tell you what, if anyone wants to add further classes, if there's a fourth and fifth or other derivatives or subclasses who will that –

[Simultaneous comments]

O'CONNOR: So this is the end of the system and then we'll go back and build the rest.

LYBRAND: Right. Right.

Transcripts were not edited.

WINARSKY: There’s outputs that comes from people participating in whether it’s a game or whatever. It’s neither query driven nor --

WONG: Like what’s the user-facing output?

LYBRAND: This is user-facing output.

WINARSKY: It’s kind of like I'm using Disruptipedia and that’s my output.

WONG: This is the government sort of –

WINARSKY: Right?

WONG: But what about the guy who’s actually participating?

WINARSKY: Yeah, there’s somebody --

LYBRAND: So there’s intermediate-stage outputs. There’s components. I mean it’s the supply chain that generates the --

WONG: It isn't intermediary because to that person it’s an end output.

WINARSKY: Yeah.

SCHWARTZ: Well, okay, but I think that’s a good point. There’s a fourth output which is continuous -

LYBRAND: Could be raw data.

SCHWARTZ: Well, it could be continuous output --

LYBRAND: Continuous update.

SCHWARTZ: -- in the form of Disruptipedia display.

WINARSKY: Yeah, exactly.

LYBRAND: Oh, very cool. That is really cool.

WINARSKY: Let me just point out, the reason that this is so important is, again, we said “open.” So the output isn't just to the analyst.

SCHWARTZ: Exactly right. Exactly right. Very important.

[Simultaneous comments]

BOTHEREAU: Is it an “ipedia”?

LYBRAND And Paul was saying that the URL is available if you want to get it.

UNKNOWN: [laughter]

Transcripts were not edited.

SCHWARTZ: What? Disruptipedia.

UNKNOWN: We should get it, right?

BOTHEREAU: No, I was defaulting. You guys made the Internet, not me.

WINARSKY: We all worked together. [chuckle] Disruptipedia.

SCHWARTZ: Disruptipedia. We've got it.

WINARSKY: You got it. Go buy it. Go to GoDaddy.com.

[Simultaneous comments]

[chuckles]

BOTHEREAU: No, no, that was Paul’s idea.

[Simultaneous comments]

SCHWARTZ: That was Norman’s idea. He gets the credit.

[Simultaneous comments]

WINARSKY: I was following your idea.

ZYDA: InYourFacebook.

SCHWARTZ: InYourFacebook.

[laughter]

THOMAS: This is all going down in the transcript.

[laughter]

LYBRAND: Fred Lybrand. InYourFacebook.com.

[laughter]

WINARSKY: Before this goes public somebody register that domain.

BOTHEREAU: We have our outputs and the build back into kind of the steps. It looks like squares are outputs.

SCHWARTZ: Right.

WINARSKY: Domain –

TWOHEY: Squares are government outputs, right?

Transcripts were not edited.

SCHWARTZ: Why don't we go to the other end and what are the inputs?

UNKNOWN: Yeah. I'll keep writing this down and come join you guys.

[Simultaneous comments]

SCHWARTZ: So we're going to use these guys down here for inputs.

LYBRAND: So systematic – So these are like that – support the bureaucracy [..?..]

[Simultaneous comments]

WINARSKY: This is query now. It’s not just a query, it’s the out --

LYBRAND: The query to system and response. So it’s a micro-satellite.

[microphone noise]

SCHWARTZ: We've actually done that systematically and what we find is it is extremely rare to have the science-fiction writer who has the right level of perception for it. Vernor Vinge is one of them actually who does. In fact we had Werner at one of the committee meetings for just that reason.

TWOHEY: I would have loved it. Sorry, fanboy.

[laughter]

SCHWARTZ: Vernor’s a …

[Simultaneous comments]

SCHWARTZ: By contrast, Bruce Sterling is wonderful and Bill Gibson is not.

ZYDA: No, he’s boring.

SCHWARTZ: Yes.

WINARSKY: You're on tape –

SCHWARTZ: No, that’s okay.

WINARSKY: This is a public transcript –

[laughter]

[Simultaneous comments]

SCHWARTZ: Bill is a good friend.

ZYDA: After *Burning Chrome* and –

Transcripts were not edited.

SCHWARTZ: He’s a great writer, he’s just not a great participator in these sort of things.

ZYDA: His recent writing’s horrible.

WONG: I feel like such a nerd. [laughter]

SCHWARTZ: But Sterling is great in these situations and so is Werner.

TWOHEY: What I mean is there’s this – We've been focusing so heavily on the technical side and like – But there’s also this – A lot of these innovations don't come from people with technical backgrounds, right.

WINARSKY: Exactly.

TWOHEY: So if you're like “Hey, look –“ If you want an idea for an artist or something to mine to come up with something there’s this – Here’s these people that are postulating on the future, like go look at Futurepedia for some potential things. Feel free to pull out of this.

WINARSKY: Right.

TWOHEY: And then if you gave people the ability – pretend we're building this – I'm leaping like six steps ahead, right, but pretend we built this Website and then you have people put these predictions out there and they're able to go attach supporting pieces of information to these things every time they happened, right. So like every time something happens it starts more to confirm your prediction and then you get points or notoriety or whatever it is. Then that might give somebody else some idea that comes with it. I don't know. I mean just getting people that don't think like me is really, really important because --

ZYDA: So, you know, this sci-fi writers thing was tried by the USC Institute for Creative Technologies.

[Simultaneous comments]

WONG: You don't go to the technology experts but you go to the people that are – like if you could get people that are actually thinking about – like the low-tech guy, right.

TWONEY: Yeah.

WONG: Because 9/11 was low tech.

TWOHEY: 9/11 was really low tech.

WONG: Really low tech, right.

[Simultaneous comments]

Transcripts were not edited.

WONG: I mean they obviously had access to like flight manuals and things like that, right, to teach themselves how to fly.

[Simultaneous conversations]

TWOHEY: Tom Clancy predicted it.

WONG: That’s true, yeah. [chuckle]

[Simultaneous comments]

WINARSKY: Another kind of input we said in our previous conversation was the narrators.

UNKNOWN: narrate stuff.

WINARSKY: The people who narrate –

TWOHEY: After 9/11, a couple months after, my friends and I got together and we realized –

WINARSKY: -- a story

[Simultaneous comments]

TWOHEY: The terrorists were stupid. They were particularly uncreative in what they were doing.

[Simultaneous comments]

WINARSKY: This is public content period.

[Simultaneous comments]

UNKNOWN: Journals, tech papers --

UNKNOWN: Tech papers, that's a good one.

WINARSKY: Also everything that Google can find.

UNKNOWN: Exactly.

ZYDA: The interesting thing about tech papers on the Internet … The stuff before that is still not there…

[two conversations carried on simultaneously]

BOTHEREAU: We're trying to figure out what does this start with. So we're going to lay out a V.1 system, what’s going in.

[Simultaneous comments]

Transcripts were not edited.

TWOHEY: So who do we have that uses the Internet that goes to lots of like really crazy places. It's actually – you want people who travel. When I want the skinny on some crazy country --

WONG: Yeah, travel channel travel blog.

TWOHEY: I go ask my friends that travel like what's – "So what's really going on in like Tanzania." So I asked my friends that were in the Peace Corps and these other things because they have this very different perspective and –

SCHWARTZ: You're right. As an ex-PCV I'm on the blogs and the intelligence that you get – it's actually fascinating. When I went in the Peace Corps before we got on the airplane they told us, "Don't talk to anybody from the embassy, they will be CIA trying to subvert you."

[chuckles]

SCHWARTZ: That was literally what we were told before we get on the plane to go to Ghana.

[Simultaneous comments]

SCHWARTZ: Within an hour of landing there was a guy next to me saying, "So, welcome to Ghana. We'd love to talk to you. Which village are you going to?" They were right there trying to subvert the Peace Corps.

[Simultaneous comments]

TWOHEY: I have a friend who is a redheaded Peace Corps volunteer.

[Simultaneous comments]

WONG: NGOs, all of those guys.

[Simultaneous comments]

GENIK: Out there.

GENIK: That's fed from the output.

UNKNOWN: This is data collection on kind of technologies that could be out there.

TWOHEY No, it's perspectives; perspectives. Because I think if you --

SCHWARTZ: What did you mean, are these narratives?

WINARSKY: What I meant here was I meant something that is saying, "Here's a –"

SCHWARTZ: It's a story I'm interested in.

Transcripts were not edited.

WINARSKY: Tell me how bioweapons could be used against us in New York City in four years. That's a narrative.

TWOHEY: Like lines at the airport for passports suck a lot. It's terrible. So if you gave somebody the opportunity to cut the line by just telling a five-minute narrative of their trip and some cool things and then you could even have some automatic transcription of this, right.

BOTHEREAU: If we were to label this section kind of like a narrative --

O'CONNOR: Inputs.

UNKNOWN: Don't they ask you where you've been anyway?

[Simultaneous comments]

WINARSKY: There's narrative inputs and then at the end there's going to be another narrative.

SCHWARTZ: Narrative inputs.

WINARSKY: Narrative output.

[Simultaneous comments]

WINARSKY: And then there's going to be narrative outputs.

[Simultaneous comments]

THOMAS: May I make an unreasonable request? If there's any way that this could stay as much as possible one conversation. I know that's a really silly thing to ask but at the same time we have a transcriptionist who's struggling very hard to keep up with everyone.

FSPKR: Sorry. [chuckle]

UNKNOWN: That's great. Thank you.

WINARSKY: I'll tell you what, here's how you do it. This is the baton. Whoever holds this can speak.

[chuckles]

UNKNOWN: We have a football around.

[Simultaneous comments]

[chuckle]

SCHWARTZ: Well, here's a question. How do we get – I don't remember who posed the question about the guy who's trying to build the device in the desert. He's

Transcripts were not edited.

not a grad student, he's not on a blog, he's not publishing a scientific journal.

[Simultaneous comments]

SCHWARTZ: What's the process for not necessarily engaging him but seeing what he's up to. How do we find out what he's doing?

ZYDA: He's unimportant --

WINARSKY: I think that's good.

ZYDA: -- unless we actually have someone on the ground who's listening to him or talking to him.

[Simultaneous comments]

SCHWARTZ: NGOs and aid workers?

[Simultaneous comments]

ZYDA: We should get that down because how are we – who's doing the listening?

LYBRAND: The journalists.

SCHWARTZ: Exactly.

SCHWARTZ: But is this the category that solves your problem, Mike? So we've got NGOs and aid workers. So we have some guy out there --

ZYDA: No, a Special Forces guys.

SCHWARTZ: Okay, we add them, Special Forces guys.

GENIK: It could be just – Well, I wouldn't put them on the same plain as military.

SCHWARTZ: It may be different. These are input sources at the moment. How we get the input may be different. So it's basically people on the ground in remote places that we're aiming for.

ZYDA: That's right.

SCHWARTZ: So that's the category.

ZYDA: Boots on the ground.

GENIK: Or tennis shoes or sandals.

LYBRAND: or shoes.

SCHWARTZ: What we're trying to do is to enable people on the ground to input to this system in some way.

[Simultaneous comments]

TWOHEY: What about also the actual people themselves? Because all those are first derivative on the person. That's some U.S. guy who's going and talking to them and reporting back. What about just – what if you had a random citizenship lottery. So like we gave a hundred people a U.S. citizenship and to get it they had to go enter some information in here and you went and talked to them. You'd get flooded with --

ZYDA: Nonsense.

GENIK: Yeah.

TWOHEY: But you'd have the data that you could actually start looking at.

GENIK: Well, look at police tip lines when you offer a big reward.

[Simultaneous comments]

ZYDA: There's a $25 million-dollar reward for Osama bin Laden. Are there any tips? No.

BOTHEREAU: So this is great. I kind of clustered these together because they seem like a parallel –

[Simultaneous comments]

BOTHEREAU: This is an information gathering exercise so –

SCHWARTZ: This is the front end.

BOTHEREAU: We can add to this but where – If we were to get this information where does it –

SCHWARTZ: That's the next step. We're still at this step.

BOTHEREAU: We're still here, okay.

[Simultaneous comments]

WINARSKY: Actually, that feeds over here.

[Simultaneous comments]

SCHWARTZ: This is something else.

[Simultaneous comments]

Transcripts were not edited.

SCHWARTZ: No, no, this was an input. This was the idea that somebody back up there was telling a story. I want to know the answer to that.

BOTHEREAU: Ah, okay.

SCHWARTZ: In other words, the story is there's a bunch of guys out in the desert doing XY and Z and I need to look for that.

BOTHEREAU: Yeah.

SCHWARTZ: That's actually part of the query.

WINARSKY: But we also create narratives by having looked at this data.

SCHWARTZ: Yes, that's right. That's another output.

GENIK: That can also be an intermediate step.

WINARSKY: I'm getting confused between inputs and outputs.

SCHWARTZ: Yeah, it's circular.

GENIK: I'd like to make suggestion that this is enough input for now and we should look into process. We can always add to this.

BOTHEREAU: Do people feel comfortable with that?

GENIK: Because we only have like an hour.

SCHWARTZ: Half an hour.

[Simultaneous comments]

SCHWARTZ: Okay, so we're gathering all this information, what are we doing with it?

ZYDA: Google.

SCHWARTZ: Now we got some triangles here.

[Simultaneous comments]

WONG: Well, is the question next how do we gather that information?

GENIK: Well, I think it's dependent upon the information that it is. I mean this you have to have people talk to them.

BOTHEREAU: Before lunch there was some talk about incentive systems for getting people to participate. Trying to get people to partner with you. Are there some incentive systems here that we need to keep in mind that are going to help us process and –

SCHWARTZ: Yeah. Are we just simply assuming that there's somebody in an office somewhere looking at public journals, calling journalists, reading the blogs, talking to people, going out there, what's happening? How's that one working?

WINARSKY: Actually, we were also going to do a scraping, a – the Web scraping of --

BOTHEREAU: Yeah, let's get that.

WONG: It just feels like the solution is some kind of like super spider thing that -

TWOHEY: You know, there's a company called Eighty[?] Legs and you're like – you can outsource your Web scraping.

ZYDA: Why bother like doing it yourself?

SCHWARTZ: We haven't gotten that far quite yet but that might be an example, outsource. Yeah, that can be outsource.

WINARSKY: We just need that as input no matter what.

SCHWARTZ: But what do we imagine is happening with all this stuff?

BOTHEREAU: Right. So where does it go? Is it going onto a Website, onto a computer system, are there –

SCHWARTZ: Twelve people sitting in a room reading it every week? What's happening?

BOTHEREAU: Yeah, are people reading it? Where's it going?

TWOHEY: Why are we assuming there's just one system?

WONG: Yeah.

SCHWARTZ: Or systems.

LYBRAND: We're not.

SCHWARTZ: We're not.

WINARSKY: No, many. Yeah. Oh, you mean many [..?..]

BOTHEREAU: It's a V.1 flow but it could have --

WONG: Well, put it this way. Maybe the first thing here is that where do people in this group put their information right now. As opposed to trying to get them to put it in the place that we want them to put it, where are they putting it right now?

WINARSKY: Newspapers, journals, conferences, blogs.

Transcripts were not edited.

WONG: Because that's exactly where we --

[Simultaneous comments]

SCHWARTZ: But it isn't being synthesized and coherently gathered.

WONG: Right.

SCHWARTZ: We have in the Monitor Group something we call the Discontinuity Committee, which I chair. The objective of that committee is to do three things. Is to (a) identify discontinuities by looking at all these kinds of things, (b) actually effectively engage decision-makers but (c) get better at doing it. Study how we do it and improve it. I would like to propose that in here somewhere we have the equivalent of such a group called the Disruptive Technologies Committee and its job is to interface with the output and users, to constantly learn and refine the input and then constantly improve the methodologies of analysis.

WINARSKY: Yeah, that's good. Very good. Great.

SCHWARTZ: So that up here at the peak of this we have the Disruptive Technologies Committee.

LYBRAND: Should we think of this like a company?

WINARSKY: Yeah.

LYBRAND: With a board, an advisory board.

TWOHEY: ….this idea before. It's like what we really want is like a disruptive – We're not trying to build just one product or being in one market, right, we're trying to provide a perspective to a bunch of other people, right. So they're going to give us some amount of – whatever this thing they're going to design, right, they're going to get some amount of money, they have a long time horizon and they just want to make sure that like the world didn't blow up on their watch, right, and like we kind of kept the train on the tracks.

LYBRAND: I think the model of this is similar to a VC in that it's a prospecting engine and it's always turning over every rock and it's very good –

SCHWARTZ: That's not a bad analogy, actually.

LYBRAND: I think it needs to be more corporate or other – again, in structure just because those partnerships are always so personnel driven and this needs to be – for it to persist over decades and decades.

SCHWARTZ: So what do we do on those committees? I'm on a – So we all go out and go to conferences, to workshops, laboratories, constantly gathering information. We come back in, we listen to presentations from companies and so on.

LYBRAND: Yeah, yeah, yeah.

Transcripts were not edited.

SCHWARTZ: We debate it and discuss it. That's the committee I'm talking about, okay.

WONG Right.

TWOHEY: What I mean is it sounds like there should be something that's like – there's going to be continually new ways to analyze this data, right. Like it would be hubristic to assume that like we're going to come up with the ultimate be all, end all today or this week or whatever. It should just be like, okay, well, if you do something and it takes a million dollars and it runs two years and then – say it takes $10 million and it runs a decade, right, and you do this ten times, you do this once a year for a decade, right. If those things come back with – that's actually not that much money in the government's scheme of things, $10 million a year, right. Like if you're able to diversify risk across a bunch of different things then that's probably worthwhile.

WINARSKY: True.

TWOHEY: If you get a couple – so what's the value – Let's put some money on this, right. If we go and run this movie contest – which I think is actually a pretty awesome idea, you know --

SCHWARTZ: A script contest.

TWOHEY: Come up with these like cool terrorist scenarios for our next action movie, right, for the next G.I. Joe movie or whatever it is --

ZYDA: But, you know, the cool ideas are not going to be on the Internet. If somebody does turn in a really cool video --

BOTHEREAU: Especially if they can cash it in for – with our committee.

TWOHEY: But what I mean is if you're the place where they're going to cash it in then you get the idea. And then you win.

WINARSKY: Right.

ZYDA: But nobody's going to see your video.

TWOHEY: No, no.

ZYDA: Because it's instantly classified.

TWONEY: Well, but that's – so it's

ZYDA: I'm just --

LYBRAND: Suspend that for a second though – you know, we can play with that, come back to the security thing.

Transcripts were not edited.

TWOHEY: Like just don't classify it. Like call it fiction and then like everyone will laugh at it and say it's not going to happen. Or put a little delay on it, put some – You know, someone's like "Oh, we're ready to liquid explosives on the airplane." And so you go, "Okay, fine, no more drinking." Whatever it is.

BOTHEREAU: That seems like it's a bit of input but it's also a bit of a process

WINARSKY: It's a motivation.

WONG: But why wouldn't you just take it off the studio sites, like just figure out we get it from them directly. They're pretty good at incentivizing people to bring the scripts, the stories, so --

BOTHEREAU: Yeah, I mean it could be another way. That could be one way –

LYBRAND: It could also be its own site.

[Simultaneous comments]

WONG: Sorry.

LYBRAND: It doesn't need to be its own thing. To your point of look for where this information already lies.

WONG: Yeah.

TWOHEY: Look, the entertainment industry is always trying to like wheedle Congress for certain things, right. So if they attach a rider

[Simultaneous comments]

GENIK: This is the analysis section. This is analysis.

TWOHEY: Like you need a little bit of soft power kids.

[Simultaneous comments]

WINARSKY: Delphic groups?

SCHWARTZ: Yeah.

ZYDA: That's what they do.

WONG: That's a good idea.

BOTHEREAU: So how else are we processing?

SCHWARTZ: Well, do we imagine – There's two classes of processing: human processing and machine processing. Does machine processing play any role in taking

Transcripts were not edited.

any of this or is this really all going into human beings and the human beings are interpreting it?

WONG: Well, I think part of it’s quantitative and qualitative, I guess. There’s going to be quantitative and qualitative information that’s coming out of this. So qualitative, I think you're stuck with human beings, on the qualitative side?

TWOHEY: But, for example, I can go write a Web crawler that goes and crawls all your known terrorist Websites, rips out all the first and second-level information from that, applies statistical machine translation and does topic classification on this, right.

WINARSKY: Right.

TWOHEY: You're only going to have like a 20% accuracy at the end of all those steps because you know the Arabic to English thing, the text categorization, these are still emerging technologies, which doesn't mean it’s not worth the government’s energy like funding research in an area but you could mitigate some of your risk by doing this and so why not? Right? I would actually be kind of shocked in the secret – the high side stuff in the Defense Intelligence Agency doesn't do something like that that I don't know about right now. I'd be disappointed in the taxpayer dollars.

WINARSKY: The beauty of what you're saying is automated processing might only work 20% of the time but actually the truth is these signals keep coming. These signals don't go away, especially if they're going to become a disruption. So even if it worked only 20% of the time, over time that kind of processing could surfaces this kind of input.

[Simultaneous comments]

SCHWARTZ: Again, if in that 20% you only get one significant hit every two or three years it’s still worth it.

WINARSKY: Right. Well, but who determines if it’s significant or not.

SCHWARTZ: In hindsight. In other words, you saw something and it turned out to be important, that’s all.

WINARSKY: Okay. So what’s success though? I mean if –

TWOHEY: It’s a counter-factual problem, right. Like you didn't get cancer because you didn't smoke so is this a success for, you know, what?

WINARSKY: Yeah.

TWOHEY: It’s hard to measure the lack of bad things, right, as a --

BOTHEREAU: So out of this are we trying to maybe come up – Let’s say out of this we came up with 50 to 75 technologies we want to track.

Transcripts were not edited.

SCHWARTZ: Hundreds.

BOTHEREAU: Hundreds maybe. How many would we want to allow to push into the rest of our flow? I don't know if we have time for all of them or the research for all of them so how would we – would there be a smaller set that – would there be a kind of filtering that would happen at some point?

[Simultaneous comments]

WINARSKY: Well, that’s what Paul was saying.

SCHWARTZ: We're trying to get at the filtering strategy at the moment. How you take the hundreds and turn them into the half a dozen that you really want to focus on.

UNKNOWN: Yes.

TWOHEY: Our take on this is that you can't do it accurately. Like that’s actually our fundamental axiom so –

[Simultaneous comments]

SCHWARTZ: Yeah, accuracy is not a –

TWOHEY: I'm not going to sit here and tell you, “Yeah, you guys can totally do it accurately.” Right.

WINARSKY: Right.

ZYDA: So we don't need –

WONG: I just thought we missed one.

ZYDA: -- the bottom point there which is really good data.

GENIK: There's always space at the top.

TWOHEY: Like I was telling you, I don't know if anything is good

SCHWARTZ: What do you mean by that?

WONG: It means that these are all things that people are doing intrinsically. We could stimulate discussion within the community if there’s a question we want to ask.

GENIK: You can hold a workshop.

WONG: Right.

[Simultaneous comments]

Transcripts were not edited.

GENIK: Like when the Army puts out an RFA, they invite everybody and only the nuts show up.

WINARSKY: Who was talking about use cases before?

GENIK: You've been to one of these. [chuckle]

WINARSKY: I'm getting stuck on a use case and how this would work. Let's walk through one use case, okay, with a launch of a small --

BOTHEREAU: Great.

SCHWARTZ: Cheap launch capability.

GENIK: So we've got a connection from there to here then.

SCHWARTZ: Yeah, so back here the loop is I have a question. I'm Assistant Secretary of Defense and I say, "I want to know about whether in the next five years somebody's going to develop a cheap launch."

GENIK: Where's our question.

WINARSKY: Okay.

WONG: Or would it be like something "I'm thinking about invading another Third World country and I'm going to secure policing action around that country. What do I think about over the next couple of years as I prepare to enter that country?"

SCHWARTZ: That might be another use case. It's a different one.

WINARSKY: So let's just follow one and go through it.

[Simultaneous comments]

WINARSKY: I'm trying to figure out – I don't what the connections are, do we all agree.

BOTHEREAU: I just took a survey of everyone else's, we are clearly winning.

[laughter]

TWOHEY: Nice.

[laughter]

SCHWARTZ: So taking your point, Norm. Take a look at this, what would happen. Michael Mack calls up the director of this program and says, "You know, I got to know about this."

WINARSKY: Yeah.

Transcripts were not edited.

SCHWARTZ: So he sets in motion with his analytical group – he's got a group of people. Here are all of your information resources. Different people within that group will tackle different pieces of this different set of sources.

WINARSKY: Right.

SCHWARTZ: So I'm going to read over the output of Web crawlers, I'm going to get –

WINARSKY: Who's "I" now?

SCHWARTZ: A member of this committee up here. We've got our committee and Michael Mack, the Assistant Secretary, has called the head of the committee and said, "I want to know about cheap launch."

WINARSKY: So that committee is an analyst committee, is that right?

SCHWARTZ: Yes.

WINARSKY: Is that what we're doing?

BOTHEREAU: Should that move down?

TWOHEY: Let's just make another one.

WINARSKY: That moves over here in the analysis stage of –

[Simultaneous comments]

BOTHEREAU: Peter, that just made it sound like that's kind of the start. You get the call and that happens.

LYBRAND: Yeah, that use case is the one that works through.

WINARSKY: This is our analysis object.

SCHWARTZ: Okay.

WINARSKY: So here.

GENIK: I mean we start with something raw that somebody says and then we do something with – we do analysis on it.

SCHWARTZ: I'm calling – the reason – this group does a bit more than just simply. In other words, the call comes in, "I want to know about low-cost launch." Now five of us get assigned to that problem of a committee of twelve and we are given some –

WINARSKY: Per output.

WONG: I think the first thing you would do if you were asked a question like that would be you'd first postulate with a hypothesis for why low-cost launch

Transcripts were not edited.

would be possible, right? Like do we think that there's a new technology development? Do we think there's a Third World country that's copied something? Blah-blah-blah.

SCHWARTZ: We think there's an urgent need that many countries have therefore they're trying to solve the problem.

WONG: Right. But the first thing you would do is not necessarily jump into the research side. The first thing you would do would be to break that sort of question down either into sub-questions or hypotheses, right?

BOTHEREAU: That's great.

SCHWARTZ: Cheap propulsion, cheap navigation.

WONG: Exactly. Right.

GENIK: So there's an analysis --

WONG: What are the drivers of that going to be?

[Simultaneous comments]

TWOHEY: Maybe something about breaking down the question?

SCHWARTZ: Into operationalizable questions.

WONG: But I think it also has to be breaking down into hypotheses because you really want to have a story, right.

WINARSKY: Right. You have to have the evidence.

WONG: We have to go back with a story, right?

SCHWARTZ: Yeah, the narrative in this case is Country X – Hugo Chavez will develop satellite-launching capacity –

WINARSKY: Exactly. Now what's our analysis stage?

GENIK: Well, yeah. But that analysis of the question has to happen in the system, it doesn't happen outside the system. So what I'm saying – I'm making a point that this line is correct, it goes right here.

WINARSKY: It goes to a narrative. Then we're --

GENIK: And then here to here. Here to some –

WINARSKY: What is that triangle? What is our analysis?

GENIK: Are we writing our analysis?

SCHWARTZ: Analysis.

GENIK: Breakdown.

SCHWARTZ: Break down the question into sub-questions and then feed it through the various input sources.

WONG: But then I think you have to develop – you have to develop a --

GENIK: These are the inputs too.

WONG: I think you have to develop a hypothesis.

SCHWARTZ: The question goes back out to this.

UNKNOWN: Develop a hypothesis, yeah.

SCHWARTZ: So which blogs are likely to surface it? Which -

LYBRAND: Story.

SCHWARTZ: Science-fiction writers surveys, a way we gather.

WONG: Otherwise you'll gather the ocean.

LYBRAND: I may be misusing the shape but to Philip's point, if I got this query wouldn't I want to have some kind of dashboard that I went to that was consistently surveying this?

SCHWARTZ: Ah, good point. Yeah, yeah, that might be.

LYBRAND: And it might throw me out something that said, "Number of mentions across all these things –"

GENIK: You're right. That's an output that's kind of things

LYBRAND: And it's just inherent –

WINARSKY: That's this.

LYBRAND: Oh, okay. Yeah, yeah. Oh, cool. Yeah, yeah. And then –

SCHWARTZ: It could be. Not necessarily but it's one way it could be done, yeah.

[Simultaneous comments]

LYBRAND: Low-cost launch is a function of these however many inputs.

SCHWARTZ: Inputs. Propulsion, fuels, guidance systems.

GENIK: There's still some intellectual content in there that you are breaking down.

Transcripts were not edited.

[Simultaneous comments]

TWOHEY: They make equipment for mining like fuel, oil.

WONG: Do you want to put that actually in

[Simultaneous comments]

TWOHEY: And they actually have internal systems for answering these kind of questions

GENIK: I thought that this guy. This is just the output going all the way back here.

TWOHEY: How do you break it down into actionable items?

WONG: You have to break down that question into sub-questions.

TWOHEY: Like *Fortune* 100 companies already have this issue like right now.

[Simultaneous comments]

WONG: Then you have to develop hypotheses for the story because at the end of the day you're going to have to tell a story back to that guy, right?

[Simultaneous comments]

GENIK: You're right, you have to separate this. I think they go down here after the narrative input.

[Simultaneous comments]

BOTHEREAU: Okay, so we've got our inputs. We've got our inputs and then we were talking about kind of the processing strategy.

[Simultaneous comments]

WINARSKY: Here's processing right here.

GENIK: So now we're breaking down the question.

BOTHEREAU: So this is – this is – you've got narratives that are – this comes out of the narratives.

GENIK: The narratives are an input to breaking down the question.

WINARSKY: So let's keep following it.

GENIK: Relevant hypotheses.

Transcripts were not edited.

TWOHEY: Can I ask a silly question here? Just a fundamental assumption. Who’s doing this? Is this all like Defense Department contractor people?

GENIK: No. We just say the process.

TWOHEY: Okay, I'm just saying.

SCHWARTZ: Here are arrows, by the way.

[Simultaneous comments]

BOTHEREAU: So that’s a good question. We're actually going to in the next stage of this after the break talk about the human and technical requirements specifically, are there any government and non-government partnerships, that kind of thing. For now I think we should just try and get like a skeleton mapped out and then we'll say where would you need to outsource.

WINARSKY: Well, I could imagine – yeah, it could be a company, it could be the Disruptipedia that --

GENIK: Make it out of macaroni too.

UNKNOWN: [chuckle]

GENIK: Brings me back to kindergarten.

WINARSKY: -- you're just providing input and people around the world are providing output.

BOTHEREAU: Now.

WINARSKY: Okay. So automated processing brings us to these --

UNKNOWN: Yeah.

UNKNOWN: So do we have the incentives that we talked about?

SCHWARTZ: We have not built in the incentives.

BOTHEREAU: Before the break we had a rich conversation about incentives.

WINARSKY: Right.

BOTHEREAU: How can we layer that in? Because that seems like a differentiator for our system, I felt.

WINARSKY: Peter’s going to start movies.

BOTHEREAU: Incentives.

Transcripts were not edited.

TWOHEY: I think that's a really awesome – I think sort of – What really worries me about the way we're designing this thing is that we're designing one process, right.

WINARSKY: Right.

TWOHEY: And I think that like the fundamental way to do this is actually to have a bunch of totally distinct processes with groups of people that don't even talk to each other.

SCHWARTZ: Well, that's what we've got here.

TWOHEY: No, but what I'm – Look what we're doing, right. We have one arrow, we have one set of things that are going through, right. Like where would we put this --

BOTHEREAU: So how would you suggest – That's a good point. How would you suggest changing the process.

WONG: Well, I think it's still a single process but you're saying that it's more than one, right?

TWOHEY: The way I think of it, I think that there's like three separate systems that you have kind of running in the little Olympic-style rings.

GENIK: Oh, out of the narratives?

TWOHEY: You have one set of people that are looking for the next Xanadu, right. So I'm going to use the Web as the example here.

[microphone noise]

TWOHEY: If somebody says, "Oh, there's this really cool idea it'd be nice if it was built." So like what – here's a horizon, here's a possible future maybe this should be around, right. And then you have another set of things looking for actually actionable technically made things. So when you see Mosaic you're like "Oh, my gosh, this is really cool." And then you have some automated tools that help you tie this to this notion of Xanadu or whatever it was. And so all the other analysis and the contingency planning that you did for when that happened, now that kicks into effect and that comes in. And at the same time when you're looking at the intersection of those two things you have another group of people that's like "Oh, hey. We're going to look at the possible futures and what's happening right now and we're going to come up with a bunch of different movies, a bunch of different narratives." And then you feed these to the decision-makers so then they can ask questions that you then feed back. So that's the way I think of it. It's not as this one monolithic process that just kind of lumbers along.

WINARSKY: That's true.

Transcripts were not edited.

GENIK: We started this exercise by saying let’s trace one thing through. That’s why we ended up with one.

TWOHEY: Yeah, but what I'm saying is we've got to be really careful because it’s not just --

GENIK: Right. Right, right.

BOTHEREAU: So how could we capture what you just said on the table?

GENIK: Is that arrows from here all going in – I mean we don't want to make this a giant nexis.

WONG: Or would you say that it’s just – are you saying it’s the same process or a different process here?

TWOHEY: I think you have like three distinct processes that are kind of running in cycles that just interact at various points.

WONG: But you just like duplicate it like so there’s a multiple, right. You're doing this in parallel.

TWOHEY: But I mean – okay, that’s just my thought. Like please disagree with me.

WINARSKY: No, it’s right.

WONG: No, I think it's right.

GENIK: No, it's right. It's right we discussed it.

GENIK: It’s how you do transcription in India, right? You have four guys that you're paying three bucks an hour, right, and then you cross-check the --

WINARSKY: Right.

SCHWARTZ: The incentive question is an interesting one. The kinds of people who we want to input this are smart, knowledgeable, observant people. Why would they wish to participate? Well, it could be money. That’s not likely to be it. But it does strike me that one of the reasons that people participate is that interesting people are listening. That is they believe that somebody at the other end is going to be paying attention that they would like to be heard by. So hypothetically, let’s put it this way, an incentive where if we constructed that committee properly, i.e. that the right twelve people – that all the people we would like to have participating wanted to be heard by. It’s Steve Jobs, it’s Steven Spielberg. I don't know, it’s Barack Obama.

ZYDA: Uma Thurman.

SCHWARTZ: Uma Thurman. Yeah, better yet.

TWOHEY: So you do this, right and you're going to go to Davos or wherever it is.

Transcripts were not edited.

SCHWARTZ: Wherever, yeah. But in other words there's some – you are heard by the right people as a powerful incentive.

GENIK: But, Peter, I think that that's part of our process.

UNKNOWN: That's great.

GENIK: Not part of the input customer.

SCHWARTZ: But this is how you get people to participate.

GENIK: Right. Right.

SCHWARTZ: It's an incentive.

GENIK: So we should make some stuff --

BOTHEREAU: Should we make an incentives --

SCHWARTZ: Attractive committee.

BOTHEREAU: Like maybe an incentives box and list out – you want to list out some of the incentives so we get that stuff.

SCHWARTZ: Yeah, you know, you want to be there. People want to be in Davos because everybody else is there they want to be heard by.

WINARSKY: That's true.

SCHWARTZ: I go to Davos every year because it is really an interesting place to be, right, and everybody else is there.

BOTHEREAU: So let's get some of those incentives.

WINARSKY: So there's another thing about analysis that I'm puzzled by – not puzzled but torn by. We crowd source a lot of the inputs. We're not crowd sourcing the analysis.

UNKNOWN: Um-hm. [yes] That's a good thought.

WINARSKY: Why don't we --

SCHWARTZ: Yeah, we need multiple analysis.

WINARSKY: Why don't we use the crowd to analyze. If you're asking how to launch micro-satellites, why don't you ask the crowd how to launch them?

SCHWARTZ: Good. So we need some feedback out to the crowd and back again.

WINARSKY: Yeah. Yeah.

Transcripts were not edited.

GENIK: Isn't that then a two-way thing there?

SCHWARTZ: Yes.

WINARSKY: Yeah.

BOTHEREAU: All right. Let's make it.

[Simultaneous comments]

WINARSKY: So we have the crowd-sourced analysis. And that goes back – that's all this stuff.

GENIK: That's in parallel with --

UNKNOWN: Move these over.

WINARSKY: It doesn't just have to come from that. The crowd can analyze any of these questions if you get them motivated to. Right. Now you really need motivation.

BOTHEREAU: Crowd source analysis. And what comes out – so the crowd is – kind of all these inputs are feeding.

WINARSKY: All this stuff can eventually be inputs –

SCHWARTZ: And through the Disruptipedia they get to participate in crowd source analysis.

WINARSKY: The crowd will make up – You want to tell me how to blow up a ship in New York harbor. Send it out to the crowd, these ideas, and let them [..?..]

SCHWARTZ: So we need an arrow from the Disruptipedia over to here.

BOTHEREAU: Where's the Disruptipedia, down here? Okay. We need another arrow.

GENIK: Down to –

SCHWARTZ: Crowd source analysis.

WINARSKY: Right.

UNKNOWN: I'm also interested in –

ZYDA: Not much process in the middle.

UNKNOWN: Yeah, that's right.

UNKNOWN: It's an Etch-a-Sketch.

Transcripts were not edited.

ZYDA: It's an agile process.

[chuckles]

UNKNOWN: They do everything in pairs.

UNKNOWN: [chuckle]

BOTHEREAU: Fred, where do these –

LYBRAND: I was just throwing those out as if I – If somebody came to me with a query, I would hope I would have some sort of answer where I would have built some kind of analysis.

WINARSKY: That's just breakdown.

BOTHEREAU: It's kind of GUI almost stuff, right?

LYBRAND: Right. I mean it's --

BOTHEREAU: So I might put it more --

LYBRAND: Similar things are recorded elsewhere over the annals of this committee.

WINARSKY: Right.

BOTHEREAU: Is it all right if I put it more toward the end?

LYBRAND: Wherever you would like it, including the circular file in the corner.

WINARSKY: So now we have somebody's output that they want, which is a micro-satellite query as to when it will or is it possible that it will be done. We go to the millions of inputs, we analyze that potential and we out put the results. So what am I missing.

[ongoing side conversation between Wong and Twohey]

O'CONNOR: Wouldn't the Disruptipedia have to be up here?

WINARSKY: Yeah, it is kind of up there.

GENIK: Disruptipedia is an output.

BOTHEREAU: Maybe this should be a part of it up here too.

SCHWARTZ: [laughter]

GENIK: Well, you know, our problem is that this is a line and we want it to be a circle. [chuckle]

[continuing simultaneous conversation with Twohey and Wong]

Transcripts were not edited.

WINARSKY: That’s kind of this, crowd source input.

GENIK: Mmm –

WINARSKY: Disruptipedia? Yeah?

BOTHEREAU: So a system and that collects all the inputs.

GENIK: I think what we mean by here is almost individuals though, isn't it?

WINARSKY: Yeah, this is individuals providing --

GENIK: This is individual provided and this is system provided.

BOTHEREAU: So we've got the inputs, we've got crowd source, incentives.

WINARSKY: Right.

SCHWARTZ: We've got one incentive, that’s all

BOTHEREAU: Yeah

SCHWARTZ: We need some more incentives.

BOTHEREAU: We need some more incentives. We had some other things here about --

GENIK: Script writing --

UNKNOWN: Maybe access to unique people. You were kind of mentioning that.

SCHWARTZ: That was the one I had!

BOTHEREAU: Interesting people, script –

WINARSKY: Participation in a script.

UNKNOWN: Yeah. Reputation.

WINARSKY: Reputation.

UNKNOWN: currency or virtual currency –

WINARSKY: Yeah, you could do a mechanical turf kind of thing.

[Simultaneous comments]

GOLDHAMMER: Ours ends in world peace, where does yours guys’ end.

[laughter]

Transcripts were not edited.

SCHWARTZ: Disruptipedia. Oh, good.

[Simultaneous comments]

LYBRAND: World domination.

[laughter]

GOLDHAMMER: World domination, excellent.

[Simultaneous comments]

WINARSKY: There's a lot more money in world domination.

SCHWARTZ: [laughter] That's a very good line.

[laughter]

WINARSKY: Is that on the record?

UNKNOWN: I saw that movie.

UNKNOWN: I saw that movie. There's a bunch of movies like that.

GOLDHAMMER: Good. A lot at the beginning, a lot at the end, some arrows in the middle. So we'll reconvene in about five minutes and we're going to do a little moveable feast where we'll share each other's tables.

[Simultaneous comments]

SCHWARTZ: We get another pass at this, by the way.

UNKNOWN: Got it.

ZYDA: Computation.

BOTHEREAU: This is good. We actually have a lot on here, this is great.

GENIK: We have to have an analysis and computation.

LYBRAND: The nice part actually is if you go look at the others, they kind of have the middle.

[chuckles]

TWONEY: So, you know, when you merge the three.

LYBRAND: There's boundaries.

ZYDA: Yeah, we have computation.

Transcripts were not edited.

BOTHEREAU: Where are we now?

UNKNOWN: I'm trying to figure out where we can draw more of these lines.

ZYDA: We're on brownie break.

TWOHEY: Oh, we're on a brownie break, okay?

ZYDA: I think.

WONG: This gets at kind of that multiple systems idea.

GENIK: Well, you really would like the ability for any part of the system to talk to any other part of the system if it needs --

WONG: It should be totally --

GENIK: It's like an abstract object class with a generic connection.

TWOHEY: It's called a phone. You pick it up, you dial it.

GENIK: Generic computation.

ZYDA: It's an API –

[Simultaneous comments]

TWOHEY: Phone numbers, yeah, they exist. I'm not being funny. Like seriously –

BOTHEREAU: You don't need a Web portal to – yeah.

TWOHEY: You need to talk to me. Like you have my phone number if you'd like to call me up. If I can answer, I'll talk to you, right.

WONG: I guess I still don't see how – I can see the system being useful for gathering data, I still don't see it being as useful for the analysis part.

ZYDA: Unbelievably analytic.

BOTHEREAU: Mike, anything you want to add before we break.

LYDA: I'd put computation occurs.

BOTHEREAU: Computation occurs, there you go. Kind of a reminder.

LYDA: Monkeys and typewriters.

BOTHEREAU: Yeah. MAT.

THOMAS: Are these stuck? Do they need to be stuck for the purpose of presentation?

Transcripts were not edited.

BOTHEREAU: Yes. But they're not because we're moving them around.

ZYDA: Don't move the page.

Team Activity: Identifying the Human and Technical Requirements

UNKNOWN: Plus you analyze what's going on.

UNKNOWN: That already exists, right.

GENIK: And it probably has some inputs of its own that …

SCHWARTZ: What's different with that than Jason?

UNKNOWN: Younger people.

SCHWARTZ: Younger people.

UNKNOWN: It's not the same people all the time.

UNKNOWN: So there's turnover, they learn from --

UNKNOWN: People, technology and partnerships.

SCHWARTZ: Actually, at the moment we're doing additions to it.

UNKNOWN: Additions, okay, great.

UNKNOWN: Tweaks, little tweaks.

[Simultaneous comments]

TWOHEY: All of the best people I know in science would never deal with classified stuff because it's too toxic to their careers and their lives. So you have to be very careful about how you approach this because there's – Look at this room, right, how many women do we have on the panel? Two?

UNKNOWN: Actually, there are two on the committee.

TWOHEY: Two, right. So I mean like already our whole perspective is – it's primarily like white dudes. This is 2009.

WINARSKY: True.

TWOHEY: So we need to make sure that like we have – there's actually a mechanism in place for projecting like diversity of opinion. It doesn't have to be a consensus, right, like that's the whole point. In fact, in the future people are going to disagree pretty violently about what it looks like.

BOTHEREAU: Was there anything on the other tables that you saw that you think – that made you re-think anything in here or you'd like to add?

O'CONNOR: The middle part.

UNKNOWN: Yeah.

[Simultaneous comments]

UNKNOWN: Even though visually there's not a lot, I felt like we had some processing here.

ZYDA: Yeah, we had computation but automated processing.

UNKNOWN: Right.

O'CONNOR: We were much more clear on the inputs and we were much more clear on the outputs and I think the other groups actually probably like hovered in the middle. If it was me, I don't if I'd spend a lot of time talking about it.

GENIK: Oh, yeah. The only thing I'd add is the parallel. I mean there's at least one parallel path that is run by the government. We don't necessarily have to tell anybody about it.

SCHWARTZ: One idea I'd like to add to this is the hypothesis engine from the first guys.

[Simultaneous comments]

BOTHEREAU: Great. Yeah, feel free to – you want to add that?

[Simultaneous comments]

ZYDA: That goes on an arrow, it goes on an arrow, right.

SCHWARTZ: It goes on an arrow and where does it go in our process here?

BOTHEREAU: From Stewart's group – yeah.

SCHWARTZ: Yeah.

ZYDA: Develop hypothesis for story, is that the engine we're talking about?

UNKNOWN: Well, there's these groups.

BOTHEREAU: Peter, were you thinking of it pretty early on or --

WINARSKY: Develop hypothesis --

SCHWARTZ: I'm thinking of it as part of the –

Transcripts were not edited.

[Simultaneous comments]

UNKNOWN: I want it sort of like part of this.

UNKNOWN: Feel free to put it –

SCHWARTZ: Well, actually, that's pretty much there already, isn't it?

ZYDA: Yeah.

UNKNOWN: Yeah.

SCHWARTZ: Okay, never mind. There.

UNKNOWN: That's a good, yeah. Add a good title for it though.

UNKNOWN: [..?..] Put "engine" in there.

BOTHEREAU: Any other tweaks, additions, subtractions, improvements?

GENIK: Do we want to put parallel structure down?

SCHWARTZ: Yeah, I think we need to put – I'm just going to put it right here, parallel structure.

UNKNOWN: They're all writing Disruptipedia right now. Putting [..?..]

[chuckles]

UNKNOWN: We've created a monster.

UNKNOWN: Now we should put it out on eBay.

SCHWARTZ: And how do we want to define that parallel structure?

WINARSKY: The parallel structure is the intelligence community side that isn't the open crowd sourced side.

[Simultaneous comments]

GENIK: It observes everything that's going on in here and aggregates it with everything else.

SCHWARTZ: And it has other pieces that may not be --

GENIK: Right.

WINARSKY: Right.

TWOHEY: Actually, I think there's another case that's not classified but it is not publicly available either. So you look at – There recently was this attack on a SSL-based Website. I'm not sure if you guys are aware of it yet. So there's a potential to have a little bit of mayhem caused by this thing called client site certificates. And so for certain people, especially on the high side that rely on this, like this is a little bit disconcerting. So you – so the IETF created this like group of people that were talking about how they're going to handle it or a DNS vulnerability last year, right. This wasn't – didn't need to be classified but you wanted to have some things that you wanted to talk about that were not necessarily distributed.

WINARSKY: That's interesting.

TWOHEY: The minute something's classified.

ZYDA: Confidential –

[Simultaneous comments]

TWOHEY: You have – there's a whole bunch of like federal and legal baggage that comes along with it and like maybe – you want to have two parallel ones. You want to have a classified one and you want to have one for some things that are must maybe not for the general public.

[Simultaneous comments]

UNKNOWN: Private.

[Simultaneous comments]

SCHWARTZ: Why don't you put on here "classified" and "private."

WINARSKY: And private groups, private discussions.

WONG: Do we want to put anything into the technology around something like a – sort of an intelligent Web spider or something –

[Simultaneous comments]

WINARSKY: That's over here.

WONG: Do we have that?

WINARSKY: Web crawler.

UNKNOWN: We have it on input.

WONG: But as a technology arrow.

SCHWARTZ: So now we're ready to move on to technologies, people and partnerships.

BOTHEREAU: So that's good, yeah. Now we can shift, people, specific technologies, and partnerships – organizations, institutes, entities.

Transcripts were not edited.

WINARSKY: Some people went in to the technology –

[Simultaneous comments]

UNKNOWN: A post-it note maybe.

[Simultaneous comments]

O'CONNOR: We could go to each note or each orange thing on the table and write how many people and who for just each one of them. If we want to enumerate the options or --

BOTHEREAU: Yeah. So we have a couple pads of post-its. So for people that could mean either teams of analysts inside the government, how many it should be, how they should be convened and structured but it could also mean specific individuals or groups that you might be thinking of already that do this.

GENIK: Is there something that the NRC could do that it's not doing already? I mean with TIGER and other committees.

SCHWARTZ: Yeah, a question for me is exactly that. What distinguishes – For example, I define this Committee on Disruptive Technologies. What is different about this from Jason, from TIGER, from other entities that have been charged with similar tasks, not identical tasks?

GENIK: Other than they have a different charge.

SCHWARTZ: Yeah.

GENIK: They're a part of this group.

WINARSKY: So these people – this takes a group of people over here to develop hypotheses, that's what they did over there in that table too. These people differentiate –

[end recording]

[following are very rough notes on topics mentioned after recorder shut down]

SCHWARTZ mentioned high levels of knowledge. Suggests a partner might be the Smithsonian. They would like a new source of revenue.

LYBRAND suggested a kiosk.

WINARSKY suggests a museum of disruptive future threats.

O'CONNOR mentions the insurance industry.

TWOHEY talks about the X Prize and Netflix' automated processing model.

Transcripts were not edited.

SCHWARTZ emphasis regular outputs, mini movies.

WINARSKY suggests partners might be movie producers.

TWOHEY asks is celebrities might fit in.

LYBRAND suggests getting data from downloads.

WINARSKY suggests TED as a partner, others contribute TED support and examples.

LYBRAND says Disruptipedia will take the longest.

TWOHEY estimates twenty groups for $50,000.

BOTHEREAU asks what can make people feel special on Disruptipedia.

TWOHEY cautions against YouTube quality movies.

SCHWARTZ reminds that there's always the occasional genius.

Feedback to workshop participants in Appendix D.

GROUP 2

Group 2 Participants:

Moderator: Carolyn Mansfield
Steve Drew
Jennie Hwang
Gilman Louie
Philip Koh
Bill Mark
Mark McCormick
Phil Nolan
Ben Reed
NRC Staff Member: Kamara Brown

Team Activity: Designing a Scanning System

HWANG: Yeah, I just want to follow up and say, you know, you use one word, “rely”, you know. No, I think this whole thing, process, the key, you don’t rely on any one of feedback. It’s really hard to use as a reference point. Not rely. That’s I think the difference from what I see. You don’t rely on any visionary, you don’t rely on anyone. You really look at integrating or --

GILMAN: You don’t rely on the…

HWANG: You don’t rely, so that’s the key word you used. I don’t agree.

Transcripts were not edited.

UNKNOWN: So --Gilman saying there are two different pillars and that may be one of the things that we're going to have.

McCORMICK: The only thing that concerns me a little bit about those conversations, I think a lot of the stuff we're talking about works really well for something that's going to be sort of passive architecture. It doesn't work particularly well with something that is a small, seemingly insignificant, that creates a massive issue such as -- You know, one that I was thinking about, a couple years ago we published in *Popular Science*, an EMP ball in the middle of New York City, you know. And let's face it, you can go to the local hardware store and get all the components to basically make one of those damn things, you know? Pretty damn close. But by the same token, you know, you start thinking about the implications of what that'll actually have at the end of the day, you know, it's a huge implication. 3340

GILMAN: Yeah. I was thinking about what Stan was saying, earlier, this idea of taking stories and have -- One way you could do it using a narrative is you say that, you say any point of entrance to your country and you place say tell me what is that? If the world was to go right for you or rotten in the next 60 years, tell me your best possible vision of that, tell us the most --

McCORMICK: Take the extremes.

GILMAN: Take those polar extremes and then use that as a way to say okay, how do we build maps? You get very different extremes.

[Simultaneous comments]

STRONG: There's some other ones like that, the outliers.

[Simultaneous comments]

NOLAN: Is it anybody or is it in fact particular types of people in that country?

GILMAN: You might treat a government leader different than a random person who walks down the street.

McCORMICK: It does give you a context because that's, I mean, that's my big issue that I see, is like I see a lot of the stuff that we're doing right now in the States is very, very U.S. centric and the reality is that the, you know, the realities -- I mean, I spent most of my life living overseas and the reality is the rest of the world, I mean, like I was born in Zimbabwe. Talk about a complete state shift. I mean, Mugabe came into power and it's a completely different country, you know.

GILMAN: So they could be anybody. The question is can you segment it and then do all the demographics and map it out exactly.

McCORMICK: Yes.

Transcripts were not edited.

GILMAN: For example, asking somebody who lives in the Midwest, you know, just a family member, it might be a very useful exercise, maybe asking a slightly different way. “What’s the thing that worries you most and what’s the thing that you really would like as your outcome?” Understanding that cultural base and helping with bias mitigation, say, “Hey look, what’s going to be technology bias or poly bias or Western bias, you know, asking” –

[Simultaneous comments]

McCORMICK: You know, one that would actually help with that is wisdom.

LOUIE: Wisdom. Ohh.

McCORMICK: Yeah, there’s a guy -- linguistic mapping. I guess you’d pull something up on that one. I use it a lot in what I do. It’s called neural linguistics and there’s a specific thing around it. But there’s a guy by the name of Dr. Michael Hall that came out with one. Think about it as like Meyer’s Briggs on steroids. There’s 64 different maps and what’s really cool about it is it maps out how you think, how you process information, but more importantly, are you the kind of person in the kind of society that makes decisions first and then thinks or are you the kind of society where you go through and -- you start to really get very predictive on how people operate on a daily basis, you know. I mean, it’s just one of the ones -- And the nice thing about it is you can use a lot of software tools these days for looking for different types of key words to figure out all right, there’s an 80% probability rate for this and things like that.

LOUIE: Interesting

McCORMICK: Pardon me?

LOUIE: [unknown]

McCORMICK: No, actually this is pretty universal.

LOUIE: Across all the languages?

McCORMICK: Yeah. I mean, but the behavioral characteristics that go underneath it are –

LOUIE: Are the same but the mapping.

McCORMICK: Are the same. Now obviously the tools, which you’re using for some of the stuff, but the characteristics are universal across all languages. The tool you’d use and how it gets implemented obviously depends upon the actual language patterns themselves.

STRONG: There’s another set of drivers that we find are often really useful when you’re trying for breadth and that is take the accepted trends and assume the trend stops. And I’ll give you a really good example, is there’s a general demographic trend that applies almost uniformly across the globe and that is urbanization. Urban areas turned out more dense, populated, and nonurban areas are getting less densely populated. That's the trend, that's the accepted trend. There's no particular sign of that changing. What would happen if that changed? And then we again back test because –

LOUIE: That's an interesting approach. You could see that it's different.

[Simultaneous comments]

McCORMICK: I'd almost say polarized, like you can actually take it, take the trend to the irrational extreme and then take it to the other end.

STRONG: Yes, yes, yes, exactly.

REED: You know, that's exactly what science fiction [..?..].

[Simultaneous comments]

STRONG: Yeah, yeah, yeah, that's what they do, yes.

[Simultaneous comments]

REED: I can tell you. Why don't we just alter the corpus of science fiction, analyze it and then figure out which ones are going to come across. Then you have your narrative. So then we need to write up your report and you just summarized your book.

LOUIE: That goes back to my "Star Trek" comment.

REED: Yeah, no, I mean, really.

NOLAN: 'Cause it does feel like there's a lot of ideas we have around idea generation. And --

REED: And if everybody…

[Simultaneous comments]

NOLAN: Well no one want the -- they're one of the funniest parts of this. When it comes to the evaluative piece which in my mind is always kind of the hole in the middle because you say technology and smarter people and they're kind of vague about that. I've heard them. Mark, are there any other?

[Simultaneous comments] Yes.

STRONG: We do have very specific techniques that don't go to consensus. And the reason --

McCORMICK Intentionally

STRONG: -- intentionally but partly because it's expensive and we need techniques that work without going to the expense of reaching consensus. So there's a

Transcripts were not edited.

technique that we use to evaluate, okay, and we're almost always evaluating relevance. So we're doing a relative evaluation usually on a five-point scale. And in particular we're usually evaluating impact to the client and uncertainty, what we know, how much we know about. And both of those on a five-point scale, relative five-point scales. So when we ask people to do that evaluation, we do go to experts. We also go to generalists and my experience is that if you only use experts you do not get good results in the evaluations.

LOUIE: CIA did a study and they call it, generalists are called the journeymen, but the journeymen have -- An apprentice doesn't know enough and experts always too much good. Journeymen ask the right questions but also are smart enough to pursue it.

STRONG: Exactly. Okay. But, all right, so we use a technique that I learned on programming committees back in the sixties and seventies. The technique is you ask a question, you know, for a, you ask for a rating, okay, and so you ask your group, small group, and every time you ask a question you also ask each of the people to rate on the same five-point scale their expertise to answer that question, self-reported expertise, okay? And you use that as a weighting for weighted voting and just take the weighted vote as the result. And it's not consensus, it's not the same as the real spent the time to go to aggressive voting. But it's – [General laughter] – it seems to get -- Look, one of the things, if we can –

HWANG: It's democracy.

STRONG: You know about the definition of a consultant as the one who sees himself as the smartest person in the world? That's the --

McCORMICK: He's not going to be a consultant very long.

STRONG: No, no, that is -- Not that he says so but from his point of view or her point of view --

McCORMICK: I just know when it's a consulting firm, you're not going to be in business very long.

STRONG: Okay, I --

LOUIE: There's another technique which is very a variant backcast, which is, you say okay, here's an alternative future, okay? So you ask a group of experts, you know, draw us the roadmap of the future. So there are a couple versions of the roadmap. Roadmap number one assumes there are no miracles, assumes no miracles, right? So using current trends – Moore's law

[Simultaneous comments]

LOUIE: -- extrapolating – but how do you get there, kind of given what's known? Well now if there's a miracle, how could this disrupt the pathway to get to that alternative future? In other words, would it speed it up? What are the things that could stop you from wanting to get there? Yeah, right. And the third one is what's the show stopper? Something that comes along that says well, that'll never happen because there's something even better, an alternative, that, or it's an impossibility that can't solve, basically can't solve this problem, can't get there. It's a variant to, a backcast, that says do three maps for every backcast, the natural, most likely way it's going to get there, one that has, you know, maybe one and a half miracles or a couple minor miracles, and what's the roadblock. And then be able then to use that as the foundation in the track and do an evaluation cause if you can't get there, then the evaluation won't work.

STRONG: But you create a roadmap with lots of roads and lots of points on the map.

NOLAN: So let me ask the tough question, which it's my job. There's a lot of ways of idea creation I've heard which feel like they can be automated, can throw out tons and tons of possible ideas. The evaluative mechanisms I've heard feel very labor intensive. What you just described felt like a good system. It also felt like one that can't scale as fast as we'd be able to scale to create these ideas, either as –

[Simultaneous comments]

STRONG: Oh, the system I was talking about is totally automated.

NOLAN: Totally automated?

STRONG: Yeah.

NOLAN: Individuals have to –

STRONG: Yeah.

NOLAN: -- evaluate

STRONG: You send out email and you say here's the question, here's your -- You send, you return, you respond with your weightings and that's it.

NOLAN: But that is automated?

LOUIE: Yeah.

NOLAN: For example, what Ben was talking about as sifting through the corpus of science fiction to spit out ideas, it's going to be creating ideas faster than –

STRONG: That's also automated.

NOLAN: I know but that --

REED: No, the generation's automated but the evaluation, you've got a lot of people.

STRONG: The evaluation involves people.

Transcripts were not edited.

HWANG: That's more simple than automation.

[Simultaneous comments]

NOLAN: I'm not saying manual versus automated. I'm talking about speed of creation. I hear the idea -- when we think of idea creation, we come up with some high speed ways of doing it.

STRONG: Harvesting will certainly do more.

[Simultaneous comments]

NOLAN: And the evaluative feel like they're even slower and I wonder if there's something we can do to speed it through.

REED: Well I think if you structure the prediction correctly, so that if you had some trigger conditions then you could do things like mine the news, right, or look at current reports and just find anything, basically, right? Get all the data you can from that area that you're looking for and just correlate it with the predictions. And then that will give you -- 'Cause predictions that don't have their conditions satisfied you don't need to look at. It's only the ones that you have --

NOLAN: the conditions -- No, I think it's the temporal problem, which is if you're mining the news, you're talking about what's known today and –

[Simultaneous comments]

REED: No, no, but you can get trends.

STRONG: If you're talking about signposts, that's what you're actually [..?..] –

[Simultaneous comments]

REED: No, no, like for example --

STRONG: No, he's talking signposts 'cause he's talking about things that it's an event that either happens or doesn't happen it in advance. Signals –

LOUIE: Signposts beforehand to say what's the signal that I'm going to need to match against the signpost? The problem is not the signals – well there's a lot of stuff in there. It's not signal and maybe not even the vision, but how do you --

STRONG: Signals include those anomalies.

LOUIE: -- how do you create this, so how do you create those roadmaps in a way that's not labor intensive, how do you create those signposts to say these are the things you should be tracking?

Transcripts were not edited.

McCORMICK: Well see, it even goes beyond that. It's like I'll give you a specific example. It's a project I did for Wal-Mart and we were doing a pretty big analysis of the entire stores and what's going on and stuff like that. And, you know, they're already really good at selling individual products. What now matters is what's the combinations, right? I think this is where it comes into other things. So I'll give you an example of an anomaly that, one of the things that came up that just shocked us – and there's a couple hundred of these that came up. The correlation between the purchasing of, you know, friendship cards, so somebody goes into, and gets a card of "I like you" kind of thing and the sale of condoms was like through the roof, you know. Sorry. I'm using an extreme example of a situation. But then there's like how do you -- [General laughter] But it wasn't obvious to them and so then it's like you take those type of cards and put them over by condoms, you get lots and lots of increased sales. You put it the other way around, it doesn't work, you know. I'm using that as a simple example but to a certain degree, you're kind of implying this is well from a macro economic perspective, a macro situation. You're saying okay, where are these relationships and those actually tend to be the trigger points that have far more impact on society than the other ones, like okay, let's track green cards and let's track condoms separately, you know.

NOLAN: But some people at this table we haven't heard from much in this discussion, and I want to make sure you guys have a chance, so…

[Simultaneous comments]

[Inaudible comments]

DREW: This strikes a resonance with me. You may be looking for, or even looking at the innovators come up with, guarantees your X. 'Cause they became innovators because of some segment criteria, which allowed them to lapse. What we haven't really addressed to any great extent are those criteria and those things that allow innovators to rise and innovate. For every innovator that rises there must be ten or a thousand --

NOLAN: That don't.

DREW: -- that don't. But in order to predict you need to understand I think what the root things are that cause this. For example, an innovator in Bagdad at some point in time said the conditions I'm faced with are no money, no ability to move around, you know, I want big things and I need a solution. And out of that some innovator came up with an IED that does what it does. Another innovator said I don't have any money. I have plenty of ability to move around. I want to make a humongous big impact but I don't have any explosives because he discovered pilots who could be recruited and that led to, you know, that was a good innovation. There must have been a thousand lead up innovations that didn't make it in the big time. So I'm wondering if maybe we shouldn't spend some energy looking at what criteria are the lead-to that would allow innovators to be successful.

LOUIE: With your scenarios you have outlined interesting conditions that caused an action or opportunities about science. Science on the problem spaces and opportunity spaces that people are naturally incentivized to do.

VONOG: Different geography

DREW: Oh, yes.

VONOG: You know, countries like India or Indonesia, they have poor people …

McCORMICK: It's an affect on issue is, you know, take anything to an irrational extreme it's bad but what's the threshold at which action starts to happen, you know, what's the point at which it's no longer acceptable and you hit that tipping point and people want to take action. The only thing I struggle with that is that's a hard thing to both ascertain 'cause it's different culturally, as well as do anything innovative. How do you measure it?

NOLAN: Bill, Carolyn?

MANSFIELD: Yeah, I was just going to say in response to what you were just saying, I wonder if it's, part of the issue is that we aren't able to monitor the communities where there's a lot of constraints. It's like my anthropology background but, you know, it's hard to get into those places, the surveys aren't effective because they're not all the time, they're not reaching people. And one of the things that I started looking at in my old job in recruiting was how to reach people that are, that don't have access to computers and how do you get jobs to them. And a lot of what we were talking about is cell phones and kind of like instant pulse data, you know, blasting out to people and getting information back. And I wonder if there are just other ways -- you mentioned before that surveying wasn't working and, you know, you can't get to these people. I wonder if mobile technology and other things that haven't been used for surveys or data collection before are ways to start accessing those populations in a way that you're surveying but you're getting mass numbers of people to get data really quickly.

MARK: Well so again I'm, I was struck by the IED example and the 911 example. So to me the, you were making it sound, maybe unintentionally, like there was one innovator who did that. Of course not. It's communities of people. So for the IED things I still think that kind of thing, what you should be looking for is the experimentation that's going on. And I think, it's not, I get the point about thresholds but I don't think it's quite that. I think people start seeing what's successful in solving whatever problem they're going to work on and then they innovate from there and make it better and better. So the – and I do think it's possible to get to people who are not Internet connected. I think we should be spending time on doing exactly what you're talking about, which is thinking about how to understand what those groups are doing, pick groups of interest and try to understand what they're doing. Final comment, you're trying to get us to speed up the evaluation part of the story. I agree that that's a whole. I'm still not getting a good impression of evaluating with respect to what. So there have been some good ideas about idea generation, throwing things out there and getting reaction to them, okay? I like the comment about a roadmap with a lot of roads on it. I don't know what to do with a roadmap with a lot of roads on it. I need to know which roads are the ones that are interesting, the ones I should care about. So that's, I assume that's what I'm trying to evaluate, which ones of these things should I care about, right?

LOUIE: Maybe and maybe not. But there'll be, pushback. If you have a lot of roadmaps, a lot of roads are bad, but you know where all the stop signs are or all the points are on those good and bad roads. You don't need to evaluate the roads [loud background noise]… You only need signals as they become true.

MARK: Right. But you put in a big "if" condition there, which is if I have the signposts that I think are really accurately going to tell me whether that roadmap, whether somebody's going down that road, I think that's a very hard problem.

NOLAN: Well something you said made me think that I'd throw out a very different idea. What if it's not individual innovators at all? What if the individual innovators put the road in only if there is a community? And so you, one – a need for sure but actually there's a community, a community of people either supporting them or all trying at the same time.

MARK: No, they're just there.

NOLAN: And the thing is communities have much bigger signatures than individuals.

MARK: Exactly.

NOLAN: So I just wondered, I mean, there's a big "if" proposition there, but --

MARK: But I think that that's, I don't know if it's always true but it's certainly going to be generically true. I was reading – I'm trying to remember which one it was. I think it was a DSB study that came out recently on this issue of capability surprise and they were giving the example of the birth of flight, of powered flight, okay? And I was thinking what a terrible example that was because there were a community of people working very hard on that, okay? Powered flight was not a surprise to them at all, okay? So the, if other people -- There's that famous thing in the *New York Times* about saying that, you know, the hundreds of years before there was powered flight and it was like the same day or two days before --

NOLAN: Oh, I didn't know that.

MARK: Yeah, a great story. But, so all that that shows is that that guy didn't know about it. So if we could connect to those communities, which do have a bigger signature than individuals, again, I think IEDs are going to be a great example of that.

NOLAN: Experts in that area.

MARK: Exactly.

Transcripts were not edited.

LOUIE: Look for the natural communities. That’s what’s interesting about communities. Communities could be groups of people, could be organizations.

NOLAN: Could be online.

LOUIE: One of the things we always say is if we ever want to figure out what a company’s really bad at, look at what their slogan is. You know, say quality is job one! No!

[Simultaneous comments]

UNKNOWN: So what we’ve got for the country is security and jobs.

LOUIE: Right, your local jobs. Well now for countries, you know, we get, you listen to the political rhetoric, you listen to the speech. In the blogs you look for certain themes where people are constantly questioning the rallying cries of kind of like somebody help me find the answer to this problem. It’s another kind of method of evaluating linguistics and speech to determine what could be interesting problems that people are really going to put resources behind.

NOLAN: Cap.

LOUIE: And cap the resources. So it could be anything.

McCORMICK: I mean, the biggest thing I look for in a company is culture, what is their culture, 'cause that’s more indicative to the success of the company than anything else.

NOLAN: Tell me more about – what do you mean by culture?

DREW: What cultures are successful?

McCORMICK: Well you know, it’s not so much what’s successful, okay, it’s how do they treat each other, what’s important to them, how do they speak, right?

DREW: Let me give you an example of why I asked? I’ve been listening now all day Bill talk about experimentation. I think it’s the root issue today. You said the same thing when you talk about communities. It’s two different words for the same concept. It’s a company’s willingness to look at experimentation.

CULPEPPER: Yeah, that’s a big part of it. I mean, like I said, if -- I’ll give you a really good example of a very well known company. They’ve just done a massive culture shift to the negative in the last ten years. And, you know, they were wildly successful and now all of a sudden it went from it was okay to make a mistake as long as you didn't make the same mistake twice, to now it’s not okay to make a mistake. So the level of risk has gone down and the only people that are getting promoted are people who don’t take a whole lot of risk. So the long term viability of this company isn’t particularly good because I know the quality of the managers and executives there and it’s horrible. But yet they have this view that they're phenomenal. So the subtleties of the culture in these situations.

DREW: So one of our tasks will be to reduce this to a plan or method. I'd still like to see how you do that. I mean, do you just look at all experimentation in a particular community, okay, all experimentation in a particular community, however finely you define it, and then what do you measure? Do you measure the second role? If there's a change in experimentation, isn't that almost more predictive of opportunity than just looking at the experiments themselves?

McCORMICK: Steve, along those lines I'd actually like to suggest something because one of the things that also kind of concerned people in the conversation is we're talking about three different areas here. We're talking about what we don't know we don't know, about what we know we don't know and what we know we know, right?

LOUIE: We think we know but we're going to. [Laughter]

McCORMICK: Exactly. But what strikes me is it's like it's almost like the tools for doing each of those is different.

[General agreement]

[Inaudible comments]

McCORMICK: Yeah, and like really, really early on it's like how do you just ID you know you don't know something, you take it in the realm. And there it's kind of like identify and define and then you get into the whole notion of you know you don't know something so now it's, you know, refine and qualify in some way, shape or form. And then you get into the whole notion of what you know you know and that's all about quantifying, right, and insuring that the fundamental principles haven't changed.

LOUIE: Or you think you know but you really don't know which is really simple.

McCORMICK: Exactly. Exactly. And you're constantly assuming the assumptions.

LOUIE: Yeah, for that to happen. And mapping's really important because you want to be able to touch each one of those lives and whatever your impulse is, so whether you're following experimentation, you're following science fiction writing and possibly literature or you're following, you know, funded experiments, whatever it is. It shouldn't be addressing all this.

[Simultaneous comments]

McCORMICK: 'Cause I think -- pardon me?

[Simultaneous comments]

McCORMICK: Like one of the things you brought up earlier like the communities, right, I think the communities fit in the second bucket of what you know you don't know and you're trying to qualify and define, right? Whereas more traditional survey techniques are far more better for what you know you know 'cause it's about quantifying at that point. I think the bigger issue from an experimentation perspective is back in the what you don't know you don't know and that's kind of the science fiction slash experimentation of hey, here's a theory we have. Let's go try it out. Let's see if it's viable.

NOLAN: 'Cause see, pushing on the "you", because -- I thought the flight example was a fascinating one, which is the system at the time, you know, in 1903, if we thought of the system as scientists and engineers around the world, many of them were on the know, many of them hadn't a clue, if we think of the problem at large, nobody had a clue. And I wonder whether the, you know, whether the "you" part, whether that functions when we're actually talking about a system -- Whatever our system is there's going to be lots of people involved with it with different levels of understanding and therefore I'm kind of struggling in with how could we even say whether the system was something.

MARK: Well but the point -- that gets back to this emphasis on openness, right? Because somebody knows what you don't know. [General laughter] So the point is --

NOLAN: Yeah, it doesn't exist at all, that.

MARK: -- you've got to get -- The point is you've got to get in touch with that. So that could be how do you do the, how do you focus on the experimentation? Back to the what do you do in the 1.0 system, I think you have to pick some communities of interest, some people that you care about, okay, and then focus --

UNKNOWN: Why would you pick those, on what basis?

MARK: Let's not worry about that now. Let's not worry about that. This is a 1.0 system. I'm going to tell you there's Afghan tribesmen and Stanford students. Those are the two communities.

McCORMICK: Actually, can I add one quick thing to it?

MARK: Sure.

McCORMICK: I think what you've got to do is get rid of political biases that exist with a lot of this stuff because there have been a number of times when, you know, at least in science there's numerous instances where somebody came up with a great idea and it was squelched for years upon years because –

[Simultaneous comments]

HWANG: I have an empirical question, you know, need the collective wisdom. You mentioned about to the, how we going to really evaluate, you know,

Transcripts were not edited.

whatever the methodology, what are you going to choose? How to speed it up by using evidence. Remind me, Mark, you were talking about Wal-Mart, remind me about the PIG, okay? They had of course, they had a lot of innovations. Some of them not glamorous, some of them, you know, but they are very much an innovator. They, the innovation come out, per one source, is come out, they really going into the market, now the customers you mentioned, and to see, not just to listen to them, really to read between the lines and observe even the silent language, you know, the body language of those in order to understand what is coming, you know, in the future. So what we are talking about on the one extreme, you know, just to put all the science fictions together and then to see why they come up, the other, of course, to, you know, all the hard data, people feeds and all those kind of things together. So regardless which extreme on the spectrum we are looking at, who are the ones going to evaluate it and how they going to be evaluated, and what are the criteria to be evaluated in order to give some meaningful things to come out. So we are not talking about that at all. That's kind of the reality to me, is how they're going to be, you know, you can have all these kind of things together. How are you going to -- that become very key. You know, collecting data is not that, I mean, it's not a real brainer. [Chuckles]

LOUIE: You being the system operator, you the system operator, doesn't have to be evaluated. If you can create enough high quality information around it, sourcing of information, it's up to the user of that information to trust or not to trust the idea.

HWANG: Well no, just to –

LOUIE: a possibility which is saying open systems –

[Simultaneous comments]

NOLAN: I'm getting the word from Daniel we need to stop talking and start writing.

[Mic noise]

NOLAN: Start generation, the evaluation area and try to just put down, you know, in writing on some of the these wacky shapes a couple of these things and then, you know, spend, get that down 'cause there were some really good conversations, and then we'll start to play around with it.

[Inaudible comments]

NOLAN: Okay, we're going to, we're going to be crazy. We're going to write. This is –

BROWN: And just from a distance because I'm not a professional in doing this. One person at a time so I can capture it, please. Thank you.

[Further conversation about recording]

[Inaudible comments]

Transcripts were not edited.

MARK: I feel that if we don’t start putting pieces of paper down here soon –

BROWN: And I would be careful.

DREW: I like this so pick your community. Only today Gilman said it has to have some sort of human and Dan was talking about science fiction, and help drive a successful science fiction writer to find his or her abilities to find human relevance.

UNKNOWN: Right.

[Simultaneous comments]

DREW: [..?..] this is tied to human, the human condition or human relevance.

[Simultaneous comments]

DREW: Communities are human relevance. That is what they are. They’re doing something.

UNKNOWN: We exist because of [..?..].

MARK: They exist for lots of reasons but here they’re trying to solve some problem, right, that’s what we’re interested in.

DREW: Here’s why.

DREW: So I don't know how you –

BROWN: Okay. Well they’re going to take pictures I think for that. So I need to kind of capture for the transcriber what you guys are saying so she can put it together, this – it’s not going to -- so I think that’s not…

DREW: Actually this feeds into say pick communities, it feeds into harvest.

BROWN: It actually does, yes, it does. Social networks, blogs. It’s the same thing.

MARK: So the picked communities –

[Simultaneous comments]

DREW: So this is the over level.

NOLAN: Yeah, yeah. These are high level concepts, brainstorm and what does that say?

MARK: Idea generation by a contest worldwide online, weekly winners. Audience is Hollywood and Bollywood.

Transcripts were not edited.

NOLAN: So this is games for idea generation, right? And the high level word there is “games”. Just give it a title.

BROWN: Now are these two the same, part of the -- No, no, harvest, harvest and this part of the same system?

DREW: Let’s discuss putting them in an order we agree on.

UNKNOWN: Yeah.

DREW: Harvest is from these, right?

MARK: Right. Well harvest could be from both, right?

BROWN: Yes. That’s right.

MARK: We haven't said what we’re doing with communities so we have to be observing them or doing something with them, watching them experiment --

MARK: Well we could do ethnographic studies of communities.

DREW: So don’t move it. Get it -- don’t, don’t put your pen away. Say what you just said. Watch them experiment. I don't know how you want to say it. But I mean, you pick your communities, you generate community surveys. But the key issue is you watch them experiment 'cause that’s, from the experimentation will arise the innovations. Self-validating, right, or self-

MANSFIELD: Sorry. I think that falls under generation.

STRONG: Mobile survey data collection. Okay. So this is the survey idea.

DREW: Maybe it’s part of that, huh? As far as those are the same kind of things

STRONG: I would stick it in there.

[Simultaneous comments]

STRONG: Harvest, yeah, this is harvest, that’s harvest

[Inaudible comments]

[Laughter]

UNKNOWN: Reapportion

UNKNOWN: No, no.

[Laughter]

DREW: Well we’ve got to be able to read it.

Transcripts were not edited.

MARK: We were doing, yeah, we were doing the high levels up here. Spelled it out said okay, goes out there somewhere.

NOLAN: I'm throwing out the third category as a possibility which is we generate ideas, which is, it's scanning in a whole bunch of other things, we're evaluating them, make some sort of prioritization. There's a communication piece. I don't know getting to a customer or involving people, but I feel like there's a handful of ideas we've had around some sort of communication piece.

LOUIE: Is that valid?

NOLAN: Well there's something going on. [Chuckles]

MANFIELD: There's definitely -- yes.

MANSFIELD: There's a narrative.

NOLAN: Yeah. I'm going to put down here some of the things that we're...

[Simultaneous comments]

STRONG: But it's, look at some place we're going to do the scenarios, we're going to -- Oh, let's see. Okay. I will just put out what we do, okay, so we do trains and but let's call it transportation

MANSFIELD: You feel like there are added levels of complexity you want to put in there? Which shapes?

STRONG: no, we're just stacking them.

MANSFIELD: Good. Yeah, exactly. And then we get to get the string involved?

STRONG: And then we have something called. So these go here and the signposts, this is recognizable.

McCORMICK: What? For what? What's defining the cast?

McCORMICK: So it's what's technology and what's…

[Simultaneous comments…]

STRONG: Yes, yes, indicators, yes, and these have other names too. We have to get the narratives, you know.

[Simultaneous comments]

NOLAN: I tell you what, since we have a lot of ideas down here, one of which, all of which are stunningly good, why don't I ask different people to just spend a few minutes, like spend 30 seconds, read yours and say kind of what it is.

Transcripts were not edited.

And that might help us figure out where to categorize it. So who did this thing top left?

MARK: Pick communities? Pick communities.

NOLAN: Who wrote that?

MARK: I did.

NOLAN: Got it. Who are you? What's your name?

BROWN: Bill.

NOLAN: Bill, cool.

BROWN: Are you Bill?

NOLAN: Okay, what's that mean?

BROWN: Speak up, please. I can't hear. Be a cheerleader.

[General laughter]

MARK: No.

BROWN: Okay, well don't.

MARK: So I think that what we should be doing is choosing to focus on a few communities in Version 1.0 and look at what they do as a source and to look at that as a source of what's going to be done.

NOLAN: Cool. Another one. Who's this?

BROWN: Don't be shy.

DREW: This one goes across this board from here to here and it simply says "iteration."

BROWN: Who are …

DREW Steve.

BROWN: Yeah, I got you. I remember.

DREW: So this is iteration but it's something that you have to tie together and it says to the harvested visions and experiments so you're harvesting here, you're data mining here, brainstorming here and the experiments to realize these visions meet the communities, that's these guys up here. If the answer is yes you continue on to I think this one, you continue on to this. If the answer is no, then there's something wrong with this earlier process. So I'd put that there and I'd leave yes to that and no to changing the system.

Transcripts were not edited.

NOLAN: Okay, good. I read this one up top, Bill, games, this idea generation via contests worldwide, online, weekly winners, audience is Hollywood, Bollywood, Sand Hill Road and the IC, as a way of generating ideas. Pretty straightforward.

MARK: From other sources.

NOLAN: From other sources. Another one. “Multi”. Who wrote that?

HWANG: Yeah, yeah, me. Multi-narratives from same set of data on environment, and they are always subject to interpretation. So if we would take one narrative, probably we’d be limited upon reading it to me, so we should have multiple narratives and that way we’ll see they integrate on every area.

NOLAN: That actually feels a bit like scenarios that I hear people talking about.

DREW: That is a lot like scenarios and we’ve got scenarios down at the other end.

NOLAN: Cause I can imagine it both in a, you know, idea creation area and the communications. Who wrote the one that says “data mine”?

LOUIE: Yes, this is data mine the Internet for new concepts and terms and go out to all the tag clouds and just start finding new words and terms and mergers.

STRONG: Oh, anomaly detection is something you can do automatically, assuming you have things to watch. So when do we have things to watch?

NOLAN: Interesting 'cause it’s both evaluative and idea generation. You can make a new area if you like.

STRONG: Well anomaly detection probably goes here and down here.

[Simultaneous comments]

MANSFIELD: Well is anomaly detection under evaluative?

STRONG: Well it doesn't have to be 'cause anomaly detection could be automatic but it can also -- see, you have to decide on the threshold so, and that’s judgment and the judgment is dynamic. It would change depending on what else.

[Simultaneous comments]

NOLAN: Signposts? Are those the conditions for the predictions? Is that what the signposts ?

REED: Yeah, those are necessary outliers that say that this is becoming more true.

[Mic noise]

Transcripts were not edited.

STRONG: A signpost has to have both a recognizable potential future event and an action, a recommended action. If it's not actionable it's not a signpost, it's just a signal(?).

NOLAN: Oh, yeah, so this is -- I'm talking just conditions.

STRONG: So these are signals or indicators, yes. Signals, indicators. The signposts are way down there.

[Simultaneous comments]

NOLAN: Who wrote these? Same handwriting.

STRONG: I did.

NOLAN: Excellent.

STRONG: Brainstorming and harvesting and this is deep dive into harvesting. This is harvest social nets and science fiction with probably dot, dot, dot.

NOLAN: Who's brainstorming?

STRONG: I wrote that.

NOLAN: No, who is doing it?

STRONG: Oh, who does the brainstorming? Okay. In general, in general yes, you can go to specific communities, you can go at random, you can go to experts. I like to do all of the above. Because what I use for brainstorming is that ideas have to all be expressed 25 words or less and the more ambiguous they are, the better.

NOLAN: Can you put some of that down 'cause that's a great set of information.

STRONG: Yeah. Okay.

NOLAN: What's this one?

LOUIE: This is an add-on to harvesting, which is specifically take a look at what I would call summaries of popular media, books, TV, movies and games. And you can go to a place like Amazon or anyone that and take a look at the summaries and extract so what are the classes and themes in there. You look and you're going to say hey, you know, what's the plot line here, and look specifically for technology as well as human conditions source.

NOLAN: Who circled that?

REED: Yeah, so actually this is along the same lines but it's to correlate the predictions. You data mine this….

[Simultaneous comments]

Transcripts were not edited.

NOLAN: So is what you get from this activity, is it a set of raw material ideas or is it actually the evaluation?

REED: Yeah, this is the evaluation.

STRONG: That could also be a signal, right, because that correlation creates a signal.

NOLAN: I wonder whether it applies to the market.

REED: Well so I kind of viewed the idea generation just as a bunch of words and then your evaluation. You need to come up with a list, right? So at least rank it.

LOUIE: Track it, kind of track it.

REED: Yeah, exactly.

NOLAN: So I think we've got that, we've got that. There's a lot of love down here we haven't seen. So everybody can hear, you want to slide down a little bit and we can get… Can't we do both? Then we can just talk about it. Okay, I wrote this one. Hi. It says plead evidence of a community of interest to make an idea plausible. One evaluated technique to say is there a bunch of people working on it or just one. Okay?

REED: But do you need more than one?

NOLAN: Do I need more than one what?

REED: One guy?

NOLAN: Well I think my argument was this, just totally me making it up, is that you need one person to invent something but it's plausible when there are dozens of people trying to work on the electric light that somebody won't get it. It's less plausible that [mic noise] without any context that somebody will suddenly come up with it. So I think the signature of invention --

MARK: Plurality of the idea of what the

[Simultaneous comments]

REED: Yeah, but the disruption is when the invention's used, not when the invention's made, right?

STRONG: Yes, yes. Correct.

UNKNOWN [unknown]

NOLAN: Yeah, yeah, yeah.

Transcripts were not edited.

REED: So what I was arguing is if you have the brilliant idea from science fiction and you say, “Boy, is there anybody actually working on the, you know, morphing the cat brain like in science fiction?” and if the answer is yeah, actually dozens of people around the globe are playing with it, I’ve got a community story is more plausible.

LOUIE: Either dozens are fiddling with it or it’s attracting some form of resource, other human beings or it could be dolls. It could be some sort of application or look at this algorithm. Could be a missed idea. Stealth, right, and it attracts –

UNKNOWN: the Geoorbital Air Force satellite.

LOUIE: That’s right. Or it ...

[Simultaneous comments]

NOLAN: I notice a lot of fine graphic artwork. Who is responsible for this great artwork?

McCORMICK: Me.

NOLAN: Off you go, Mark.

McCORMICK: All right. I’ve got a couple here. A couple of you probably know lifecycle, Gartner, something like that, where like as stuff is coming up here, nice thing about it is you’re going to know about it beforehand before it really becomes like. This is one that people probably don’t know. It’s innovation, well it’s actually a different triangle.

BROWN: Could you – I couldn't –

McCORMICK: The theory is that there’s four fundamental ways to differentiate it, innovation, performance, breadth and cost in every single market for this through a natural cycle. And basically --

NOLAN: Could you give an example so that everybody –

McCORMICK: So let’s take cars. When cars first came out, it was horse and buggy; they were very innovative. And then basically it was all, you know, key characteristics, how fast does it go, things like that, performance. Then all of a sudden brands became really important, right, so it’s a one-stop shop. I can go to buy a truck, I can go to buy this but I know in this one it’s going to be good. That’s the breadth category. When you get to cost it’s all about that is the most important thing. Now here’s the dangerous thing about it. At each of the four corners, sorry, three corners, it’s a really critically dangerous place to play 'cause if you’re the fastest and somebody comes out with something faster, you’re dead. There’s always sort of the inverse as well because there’s the fastest, there’s the slowest, there’s the most expensive and the least expensive. It’s like Rolls Royce actually plays in this.

Transcripts were not edited.

LOUIE: But you want to be an extreme.

McCORMICK: Yeah, you either have to play at that extreme or not. Now here's the other place where -- You get lots of disruption going from here to here and from here to here, it's when the natural market shifts that you get a massive level of disruption from here to here. So think about like the horse and buggy to all of a sudden the car. The car came out and all of a sudden you went from horse and buggy playing down here to suddenly, you know, some radical innovation.

MARK: What you were explaining to me, an example I thought that was fascinating, Mark, was the disruptions within a triangle are often to the players outside and the disruption when you hear the reset can be to the inside.

McCORMICK: Correct

LOUIE: Yeah. That is very good

[Simultaneous comments]

LOUIE: So can you write that theory in the back of this book so I can capture it.

BROWN: Does it have a name?

McCORMICK: It's actually called a peer team.

UNKNOWN: Yeah, kind of ride on the backs of this–

McCORMICK: And I've got a bunch of that stuff for us.

[Simultaneous comments]

BROWN: What was theory? What was the name of the theory? Mark, what was the name of the theory?

[Simultaneous comments]

McCORMICK: All right, next one really quickly, Ansoff matrix, which is basically markets and technology. So new markets need new technology, etc. What's interesting is the level of disruption. When you have a new technology going to existing markets you have a certain level of disruption that takes place. When you have a new technology going into new markets you have another order of magnitude, longer adoption cycles, all kinds of things like that. Just one other model to look at! And here's a classic one, Jeffrey Moore, you know! What is the technology, what exactly is that as is that ? What's it going to take to get?

LOUIE: Is that a tech or an application?

McCORMICK: Pardon me?

Transcripts were not edited.

LOUIE: a tech not an application.

McCORMICK: Yes. Metaphoric analysis, I've got a bunch of stuff to show you. This is the analysis, all right, so 64 different categories, you know, you can start to figure out how people think and how they react. And the last one I had was sort of profit motivation and scenario analysis, so what exactly is motivating people to do what they do at the end of the day and getting down to -- actually, this goes with this last one. Sorry. Second order analysis. What I find is combining these two is really powerful.

NOLAN: I understand second order analysis conceptually. Is there a process that automates it or allows it to happen more quickly?

McCORMICK: Well it's, honestly, it's going out and asking somebody, "How do you feel about X? Now how do you feel about Y?", all right, and you get something really weird -- I mean, head goes to the side and … They had a complete picture.

NOLAN: Or it may not even be just them. You say so many -- A survey says that X number of people think about this is in a certain way. How do you feel about that?

McCORMICK: Now how do you feel about feeling about that?

NOLAN: Yeah, yeah, wow.

McCORMICK: It's that second, so it's not just, you know, I have a feeling about those people but it's not like a. It's actually .

NOLAN: Cool. Thank you. That was very nice. Okay, Gilman, I noticed you're . Wait, it's Phillip.

KOH: Let me just -- I think basically talking about measurement of impact. You know, I think in the sense that you kind of identify, you know, those having the strongest impact or moderate or the least impact. Help us to identify, you know, a real estate can move forward. Market survey, I think that's, primarily I think that's one of a real estate so have to kind of, you know, collect ideas, you know, identify way of expectations from the consumers or from the market itself, you know, what are the refinements required. So I think that's kind of more, I guess it's more the evaluations of.

NOLAN: Gilman, you're a here.

LOUIE: Oh, this goes way down at the end but --

NOLAN: Why don't you tell us about it.

LOUIE: It's impact analysis, is understand a day in the life of, a day in the future life, which is basically –

[Simultaneous comments]

Transcripts were not edited.

LOUIE: It's playing the scenario out for the crowds.

NOLAN: Give me the context.

LOUIE: Yeah, give me the context.

STRONG: But that really is, that's really where it goes.

NOLAN: What about some of these other ones?

STRONG: Okay, so scenarios impact analysis, thinking, the envisioning. This is human work that needs to be done. This is not machine work, okay? On the machine side we can recognize, once we know from here what we're looking for, so we've got to have, for this kind of thing we have to say, you know, we can't just look for everything. We have to know what are the search terms that we're interested in. We can then find technology trends and specifically measure. So the measures of interest are things like the energy density of batteries, and you can measure that several different ways. It's actually many dimensions have. Okay. So between this and this there's a whole bunch of techniques for turning the crank generating signposts. You need the measures of interest in general but there are ways to get signposts without measures of interest. The signpost is a recognizable potential future that also has a recommended action. It's not actionable, it's just a signal, it's just an indicator, it's just some place on a measure of interest. Okay, with signposts you can then synthesize what we could call that roadmap with lots of roads, okay? This is a prioritized vision network with signposts, okay? And visions are the things that correspond to the scenarios. There are scenarios for visions actually. And this is actually a two-dimensional path and the two dimensions are impacting, this is kind of reinforcing that point.

NOLAN: So let me ask that we do -- Before we organize any further and I have a couple ideas how to do that, let's --

McCORMICK: Actually, something that Ray had actually talked about before that was really important was, you know, the extreme analysis.

NOLAN: Yeah, yeah, yeah.

McCORMICK: You know, and adding that in with that 'cause I think that's actually, it actually defines what the game plan.

STRONG: It's another of the techniques.

STRONG: There's a whole bunch of techniques that.

[Simultaneous comments]

NOLAN: So what I'm asking everyone to do before we do anymore organization is some of these activities or concepts are those which can only be done by humans, vary, and I'm going to call it manual but done by humans for the H.

The humans are the real critical factor. Other of these are more automated. Some are going to seem rote. Yes, can we just go through and if you've written one of these either write a big H, a big A or if you can't decide, put both, H and A.

MANSFIELD: We could also mark it in different colored stickies or something.

[Simultaneous comments]

STRONG: Semi-automated is really the best we can do for these.

NOLAN: Human, automated or it's actually, it has to be one or both. And just try to go for one. You know, it's an extreme but push it as far as you can. Then we'll organize.

[General Conversation while doing task]

NOLAN: Our goal we have here are two things which are very difficult. Number one is make sure we're oriented only in the looking only in this direction.

MANSFIELD: So this is going to be stuck on an easel to present. Does that make sense?

[Simultaneous comments]

NOLAN: Wait, wait, that's an easy one. The slightly harder one is we want to do more -- Right now we have like a few big clusters. In a couple places I've heard people talk about some interesting A to B connections. The A to B connections are the ones we want so we're going to be rebels and we have glue sticks and somehow make it happen and [noise] Carolyn knows how but I sure don't.

[Side comments]

McCORMICK: It's so much of this whole thing of how much of this, which of these break out and how they break out between what we know, we don't know, what we know we don't, you know, kind of thing and start to break out. It just strikes me – otherwise the context is, we're mixing it all together.

[Side comments]

NOLAN: Let's go through some connections, right? So what kind of [mike noise] -- You watch people, you pick communities, you generate ideas. These all look like they're parallel, right, harvesting –

[Simultaneous comments]

MARK: Like pick communities has to go in front of this.

MARK: Harvesting's a little bit further down.

NOLAN: Well it's harvesting, right? This is harvesting new concepts from

Transcripts were not edited.

[Simultaneous comments]

DREW: I'd say that's a generation game. So harvest is maybe a funny word for. It's generate team concepts.

[General Conversation] [Laughter]

NOLAN: The automated idea generation things are the easiest ones for, the first one you can do. You can do that before you have communities, right?

REED: Or if you have like communities that don't get funding. [Chuckles]

NOLAN: Well the thing is, none of these actually have to be complete ideas. They're all additive, at least right now.

[Simultaneous comments]

STRONG: This whole system ought to be something that could feed back from all kinds of places, not just from the end and iterate through. And that's a human judgment decision.

[General Conversation] [Laughter]

NOLAN: Yeah, a block, big blocks will work nicely.

LOUIE: The stacking ones have a natural connection, but most of the stuff can be done parallel, clustering.

[Inaudible comments]

NOLAN: Steve, when I scribble this very broad category that's evaluations, it both includes filtering, which is --

DREW: Okay, so there's some discriminating. That's good.

[General Conversation] [Laughter]

MANSFIELD: So if someone can start to be in charge of connections, which can be done with or with arrows or with markers

[General Conversation] [Laughter]

MANSFIELD: The other thing is if there are subcategories that these are being organized under, it'd be good to I don't know if that exists or not. Maybe we're just throwing them in.

[General conversation]

DREW: Can you hear anything that's been said?

Transcripts were not edited.

BROWN: Uh…

DREW: You're doing what you can.

BROWN: I'm used to it. I've done this kind of stuff before so it gets kind of wacky. Yeah.

[General Conversation while doing task]

NOLAN: from the communities, is that right, the identifying?

STRONG: No, actually that's more of an evaluation.

NOLAN: So where does community?

McCORMICK: Where's the what?

UNKNOWN: How do we identify new communities?

McCORMICK: That's probably going to come out of scenario analysis. Actually one of the ones I think is probably going to be the most critical in this whole thing is going to be the scenario analysis.

[Simultaneous comments]

NOLAN: It would be one of the things.

[General Conversation]

LOUIE: I think a long term forecast is you're not --

STRONG: Because you actually need signposts, you need something clear to vote on.

LOUIE: The thing is, the vote, what you vote on is when a signpost or if it's going to get hit at all.

STRONG: Right, right.

LOUIE: That's where to expect --

NOLAN: One of the things that your decision maker may be interested in is just keeping an eye on that, market and grows every single day.

LOUIE: And you also pay for signals. In other words, if somebody delivers you a signal that's useful, then you reward them.

[Inaudible comments]

STRONG: And this actually generates more signals, the prediction market generates more signals to feed back into the system.

Transcripts were not edited.

NOLAN: Okay, we've got a huge feedback loop going here. How are we doing?

[Inaudible comments]

MANSFIELD: All right. Just set this up. We have about 7 minutes to put this together.

MARK: Everything is in absolutely beautiful shape.

[Inaudible comments]

GOLDHAMMER: Guys, so I can get your attention, if you can stop conversations just for a second. This is what we're going to do. We're going to -- why doesn't everyone come to this side of the room. Everyone come to this side of the room. We're going to move around the room and see what everyone has created. We'll have an opportunity for a quick sort of report out and feedback and then we're going to go to a break. So if everyone can come to this side of the room.

[General conversation]

Team Activity: Identifying the Human and Technical Requirements

GOLDHAMMER: Okay, so you're supposed to be back with your teams, trying to figure out these additional requirements…

[General Conversation]

MARK: So okay, cool. That works. My question is whether there's also people who are specializing in doing this sort of analysis for a living, they may be some sort of consultants or something like that, they've got process.

KOH: See, this can be automated, too, right?

UNKNOWN: Or you find somebody who …

[Simultaneous comments]

McCORMICK: 'Cause that's what they specialize in.

DREW: So you need both analysts as well as other analysts, plot.

[Simultaneous comments, banter]

NOLAN: I think we're weaker on our output side and we've got, we're much stronger than the other teams

McCORMICK: Also you could put this in front of that.

McCORMICK : In front of that.

NOLAN: Yeah. This sort of analysis felt like it was very different, you have very, you know, more thought through the other team. The front end stuff felt in many ways, like ours were similarish to them. And the output, I think we've got a couple good examples in there, which was more comprehensive.

LOUIE: And the way I look at it is that they're more traditional, intelligence community process. This is like how do you take a big net and fish.

LOUIE: Yeah, there's a lot more of the fish in here. There's a lot more fish and it's kind of interesting because kind of different value propositions.

McCORMICK: Well that one also assumes really big brains.

LOUIE: But this requires a lot of expertise too. I mean, signpost generation and --

McCORMICK: This is more process expertise than content expertise.

MARK: It feels like that team may have a bunch more people who inside the intelligence community experience, which is thinner on this team. I don't know why they went for 2.0

LOUIE: Hey, it's very much crowd sourcey

DREW: The contests look a lot more like the brand intelligence process.

UNKNOWN: It's because they have some web 2.0.

[Simultaneous comments] [Laughter]

MARK: 3.0. Isn't it 3.0 when they get it right?

UNKNOWN: That's true.

McCORMICK: Or was it 2.6?

MARK: Remember the whole, you know, when your phone and they're busy saying this is, you know, generation 2.6? You know, like how do you do generation 2.6? And I haven't heard that --

McCORMICK: They're about to do it again.

MARK: I haven't heard that language recently. Okay, great.

[Simultaneous comments]

McCORMICK: A lot of people can't fully implement 4Gs in the rallies(?) and they're doing 3.5.

Transcripts were not edited.

NOLAN: Okay, this actually some of the most brilliant stuff ever struck out by the hand of man and woman. [General laughter] I'm saying that with humility.

[Inaudible comments]

MARK: I mean, just to take that thread for a second, one of the hardest things is when we're doing a to separate things like thought, volume in terms of noise from, you know, the little whisper of new ideas. I don't know what the system is for doing that but --

McCORMICK: is a system. I think it's How do you layer it so you can go from big picture things to lots of detailed data and backup

[Simultaneous comments]

McCORMICK: In other words, you overwhelm somebody with too much information and you've got to be able to layer it in to be able to say all right, these are.

NOLAN: That's good 'cause I wouldn't even thinking of that. I was actually just trying to take a different blind story, which is some of these voices are going to be screaming and other voices are whispering and this huge flood of data that we're collecting, you know, like how do we amplify the whispers and --

McCORMICK: Especially important ones. It's like they might be important but not urgent whereas other people are trying to create importance…

LOUIE: But there's an organization implied here that's not really in here, which is there's an organization implied that lives on top of this, who is querying, asking, poking, provoking, yeah, and concepts because this is kind of what I call driven focused, vision driven focused. In other words it starts with what does the future look like and then finding a way backwards into the technology versus other approaches which starts with here's this technology. What does it mean for the future? So that we have a different kind of filtering mechanism that we say if it doesn't really affect any powerful vision, we're probably not going to consider it.

McCORMICK: So one of the key criteria's about it is you have to have people who are extremely curious.

LOUIE: Exactly.

McCORMICK: Unbiased and extremely curious.

LOUIE: Very.

NOLAN: So let me also ask is there a way that the decision-maker, who right now is kind of at the end of the train, can say, "Gee, I, Mr. President, am wondering what about X, Y and Z. Can I somehow filter, dig in here and see if there's any ideas related to asteroids because I saw a movie and I was just wondering about asteroids."

UNKNOWN: Yeah, so what that – you would change it --

LOUIE: Well the would've been put in the input so [General laughter]

NOLAN: That one's actually easier because that one would say demonic possession. Probably not in "What's the technology of demonic possession? I'm the President. I want to know is there a way to kind of…"

LOUIE: So the asteroid one is the easier one 'cause it starts with a vision. I see a vision of an asteroid hitting the Earth. What are we going to do about it? So then you kind of work your way backwards. The harder thing is here's a technology discovery. What can happen?

McCORMICK: Right. A technology looking for a home.

LOUIE: This system may not be the best system for that. I mean, one of the other systems might be more interesting to use, which may be system one.

NOLAN: So an example might be -- So when I was in college, high temperature, super connectivity, maybe going from what is 12 degrees C to 90 or 80 degrees, a huge breakthrough, they thought. Of course never did that. If that happens, it's a technology disruption but what we're interested in in many ways is the impact of the technology, not the technology itself.

LOUIE: Yeah, exactly.

NOLAN: So how would our system?

LOUIE: You would look it up in the signpost maps to see if anybody had on a map --

NOLAN: A story that was related –

LOUIE: -- related that, where that thing could enable, right.

NOLAN: Oh, so actually it would be the –

LOUIE: It would be a signal.

NOLAN: -- power transmission. That's actually the thing that you might, might be critical in your story.

LOUIE: Right, because it becomes the measure of interest and it becomes a signal and becomes a signpost because you can make a decision. If that comes true, now you have some choices you're going to have to make. That's all on this side. First you start on that side.

Transcripts were not edited.

[Simultaneous comments]

McCORMICK: You could basically create from that the set of hypotheses and the signposts and then feed it back in there–

[Simultaneous comments]

LOUIE: Exactly right.

McCORMICK: -- and what you're looking for.

LOUIE: Right, exactly. Then you create new stories. Right, and that's how it

NOLAN: I feel like that we have to do the complete system. Is there anything else we can add at this point?

McCORMICK: You know, actually there is one thing. What we don't need is some kind of like a So it's like all right, it's, we've got the stuff that's noise over here and then it goes into subjects of interest, then it moves into all right, these things actually have the potential of becoming really, really critical, which then, all right, these are the ones that actually really are critical. And we don't have any like mechanism for that.

STRONG: No, we do have one. It's right here. It's not explained even to us there. And in addition, if nothing else, the decision-maker or the senior manager of this organization might want to be able to say, "I need I need some information. How many ideas can be generated, where you guys are in the process, which things" -- This is the kind of thing that you can seed– I mean, you can change this depending on the usage.

[Simultaneous comments]

NOLAN: That's right. Impact depends on.

McCORMICK: There's the monitoring system for the process and then there's the stuff that's actually in it.

LOUIE: So if you're the Department of Defense --

McCORMICK: Well I think you're onto a good point because part of it's also, like if you're not getting a lot of change happening on the front end, you make your system starve.

LOUIE: Yeah, that's the only thing I'm interested in, which is --

McCORMICK: When are people asleep at the wheel because it's just too easy and they're like –

[Simultaneous comments]

STRONG: Or when do I -- Maybe I can't do all these things in parallel. Maybe it's too research intensive. Maybe I have three or four of these and they're working really well. When do I say I'm dropping this one, I'm picking up that one because I'm not getting the kind of fresh ideas I need?

LOUIE: Well basically, you know, what's producing these fresh new visions. Then you begin to track which ones – not just by quantity or by quality and diversity. So am I getting enough from, am I getting enough visions on how technology's going to affect that? 'Cause you might say no, I'm not getting…

STRONG: What a great experiment to do, for us to compare harvesting with brainstorming.

LOUIE: Yeah, yeah.

UNKNOWN: I would love to see that comparison because there'd be two teams and you can have one on the harvesting –

LOUIE: I'd be very interested in how some of these are going to --

McCORMICK: And actually, the competitive component's actually pretty good because if you have multiple teams going through each one of these and you're pitting one against the other, you get lots of different perspectives, it kills the group think issues, etc.

LOUIE: That's right, that's right. Because again, the measure isn't accuracy of your predictions. The measure is breadth of your preparedness.

NOLAN: And we may find that some of these evaluate, the evaluative processes are going to be responding more towards different types of users. So maybe in fact you're like nothing seems to be --

McCORMICK: Working on that one.

NOLAN: -- working on this one, the chasm, we don't have anything crossing the chasm, and we need to be asking ourselves is it because nothing's crossing the chasm or is this an important kind of evaluative filter and we're not generating enough ideas to hit that?

UNKNOWN: Or you need a new filter.

UNKNOWN: Yes.

STRONG: That's a way to generate signposts because I think that's right -- You know, each of the models, the hype curve, the chasm, each of those templates is a template that can be used to crank out signposts, what we call candidate signposts. Then you evaluate different

[Simultaneous comments]

Transcripts were not edited.

McCORMICK: And then ironically, the metaphor of analysis is a great way of actually picking up how people start changing and what they're talking about, so you can then use it for sensing for like logs and stuff like that, these key words, you know, to figure out, okay, here's a state change on that.

DREW: That's good 'cause one of the -- People, technology and partnership. Earlier Gilman said gee, one way to approach this is to take a norm, take the norm, cut down the 95% pieces and then throw away everything in the middle. Is there a way to do that?

McCORMICK: Yeah. It's actually a pretty easy one.

DREW: It's not the only way to do it but it's --

McCORMICK: I mean, actually it's like, we did, I did analysis for Microsoft where basically we went on source gorge and basically did a full analysis of all the open source projects out there. You pull out the first like obvious ones and then everything that's really the fertile grounds, everything in the next like 100, and –

DREW: So where is that here? Where is that concept with blanking out everything in the middle? I mean, that's a --

STRONG: It feels like an important early filter though, before we spend a lot of time doing the detailed .

DREW: So how – what people, technology and partnership would you need to do?

LOUIE: It's right in here.

NOLAN: It's actually -- You know what, I think where it plays in is it's sort of another element of the scenario analysis in other respects.

STRONG: Scenario is not just the narrative. There's a lot of thinking that has to go into

McCORMICK: In scenario you're always talking about typically extremes. And then you say the reality is somewhere between all these different extremes that we've talked about, you know, both positive and negative.

STRONG: I mean, some of it is explaining what the implication of a measure of interest is. And see that, you need all that and somebody has to write that down and explain it.

LOUIE: Matter of fact, what you could do is you take your comparative analysis engine and apply it to the scenarios themselves. Has this scenario already been told by other prediction systems? And if the answer is yes --

McCORMICK: One more day.

Transcripts were not edited.

LOUIE: Yeah, one more day, or maybe you don't even worry about it. Just go on to the next,

[Simultaneous comments]

STRONG: Actually, that's really good what they were saying about. That is like something that can be done I'd love to do that and …

[Simultaneous conversations…]

[bell rings]

McCORMICK: Look at it and say oh, okay, wait a minute. There's a whole scenario here At other times you might just say okay, we'll just take that out, you know. So I actually think, the nice thing about it is like there's enough tools to automatically generate that stuff and then you need the human intelligence to say all right, you can logically take this out. Why don't you just take that out.

STRONG: And it's enhanced human cramming the right kind of drugs and meth into these people so their brains are working [General laughter]

UNKNOWN: That's another one for the future.

[Simultaneous comments] [banter excluded]

STRONG: And remember, they're going to lose some other characteristics like ability to make friends.

UNKNOWN: Yeah, you've been trying to play that for a while, haven't you?

LOUIE: Yeah, works out here, Pac Bell. [Laughter]

[Banter excluded]

UNKNOWN: Okay, so where are we putting this LSD factor.

UNKNOWN: So any time we have procurements we need super humans.

[Simultaneous comments]

LOUIE: Well you know, in some ways, you know, here we can do, we can extract tags. I mean, which one of these scenarios have tags showing?

LOUIE: What new key words are showing?

LOUIE: You know, what new concepts are being -- I mean, there's a lot of stuff being worked on in some engines.

UNKNOWN: The standard sort of 20 analysis.

Transcripts were not edited.

LOUIE: Yeah, exactly.

[Simultaneous comments]

LOUIE: But I think we should note that, that there – I don't know how to do it but we need to write it on the board itself, listing why an organization who is going to be this process.

NOLAN: I think it should be right here. Why don’t you write it there in a nice big box, every note is a macro story.

[Simultaneous comments]

NOLAN: Write it on the paper.

UNKNOWN: people who are managing the process. Yes.

[Simultaneous comments]

LOUIE: And generally a lot of these boxes correspond to one person, a manager, not a team manager. One person. Some

UNKNOWN: You know, actually I kind of like the idea of having competitions.

[Simultaneous conversations…no longer talking as a group…background noise loud]

LOUIE: Feedback loops.

UNKNOWN What I usually find for adoption for technology, it’s always you’ve got this great idea but there’s one little thing that’s missing. And once that happens, boom, it takes off like a rocket.

UNKNOWN: Well it’s hard to identify that.

UNKNOWN: Yes, it is.

UNKNOWN: Because the web, remember the web, never thought anybody would hand code HTML, right? But yet everybody did, right?

UNKNOWN: They did, that’s right.

UNKNOWN: And so it’s not always easy to –

[Simultaneous comments]

UNKNOWN: But also the thing about this. Look also what happened to the number of web pages as soon as you started creating the automated tools.

UNKNOWN: Yeah, yeah, yeah. But I think the disruption happened before that though, right?

Transcripts were not edited.

UNKNOWN: Sure, and some of them it does.

UNKNOWN: It just happened better after. [Chuckles]

UNKNOWN: I mean, some of it does happen but doesn't because like there's some technologies that absolutely cannot be adopted, right, unless certain things are Whereas other ones, you're right. It's okay, you could sit there and go all right, there's a basic enough level of code that I can kind of figure this out. 'Cause let's face it, there was already a skill base of people who you know, and HTML isn't exactly that complicated of a programming.

UNKNOWN: So another example, is actually domain naming, right?

UNKNOWN: Yeah, yeah.

UNKNOWN: I remember when I was and I was working on Internet technology and I thought, you know, my mother --

GOLDHAMMER: Okay.

UNKNOWN: -- will never understand any of this. There's no way --

GOLDHAMMER: Why don't we come back.

GROUP 3

Group 3 Participants:

Moderator: Jesse Goldhammer
Harry Blount
Stewart Brand
Mark Culpepper
Danny Gray
Darrell Long
Ken Payne
Paul Saffo
Al Velosa
Stan Vonog
NRC Staff Member: Sarah Lovell

Team Activity: Designing a Scanning System

GOLDHAMMER: All right, so why don't we sit here and let's talk a little bit about what we're going to try to do here.

GOLDHAMMER: So, you know, this is a little bit of a tricky equation. We –

Transcripts were not edited.

[Simultaneous comments]

GOLDHAMMER: -- a little bit of a tricky equation 'cause we've got some design criteria that we identified that has disappeared but that we identified over --

BLOUNT: They're going to move us over there?

GOLDHAMMER: We're going to be moving over there. So our design criteria's over there. So we have a set of design criteria that we came up with. We wanted it to be persistent, we wanted to identify anomalies, there was a third, which will come to mind in a moment, and we should talk about what's the process, what's the process we want to use, like how do we want to tackle this problem? There are a lot of different elements of a system. Where do we want to start?

BRAND: In foundational terms, persistence, the idea there we're cycling through the persistence might not be a bad way to approach the algorithm.

GOLDHAMMER: Okay. So just to start from the beginning with the assumption that there's some big loops, big persistent loops?

BRAND: Or a sequence of revisitings or something – like iteration one, resolve to two, that kind of thing.

BLOUNT: I think one of the questions is just composition of people involved 'cause bias came through very clearly, bias mitigation came through very clearly as an issue that we need to deal with. And so how do you thoughtfully construct the right or incent the right – people to participate including diversity

GOLDHAMMER: Yeah. Well I think diversity, I mean, I think based on the conversation I heard earlier, making sure that we have mechanisms for incorporating lots of different opinions from around the world is pretty critical.

BLOUNT: A basic one, I mean, a real, real basic one is the on-Net versus the off-Net population. We're thinking about this from a data scraping, readily available model but, you know, the question I think of Ken is, you know, the guy that doesn't necessarily access the Internet causing disruption. So how do you account for that in terms of the concept model?

VELOSA: Well the other thing though, this is an exceedingly over-educated group. I mean, I think the worst-case scenario is we have a Bachelor's. So I think it'd be ideal to get --

BLOUNT: Thank you. [Chuckles]

VELOSA: Right. So, but the central point is we need some folks who are like only high school, right? I mean, it'd be great to get somebody who's – and below, right? I mean, 'cause there's plenty of folks --

Transcripts were not edited.

GOLDHAMMER: Very much so.

VELOSA: -- you know, and I'm talking not just over there, I'm talking U.S. You know, we need both, U.S. folks at that level, 'cause I mean, they can really contribute still but, you know….

GOLDHAMMER: So just to give a practical spin on that, to borrow a page from Stewart's playbook, like you can imagine doing a set of workshops in mega cities, and mega cities or something like that. You want poor, uneducated, highly entrepreneurial and inventive off the Net, although they probably are on the Net.

BRAND: They're probably more on the Net than we are.

GOLDHAMMER: They probably are but, you know, I'll get a couple of criterias in.

VELOSA: Yeah, and actually the definition of "Net" is weird, depending on the population, because one of my cousins-in-law, he only does stuff on his phone, right? It means a high-school graduate. That's it, right?

GOLDHAMMER: Yep. Okay, so definitely a lot around diversity, a lot around persistence, we need feedback loops, we need young.

GRAY: We also need, I think we also need to see the older folks as well. I hate to keep coming back to that but I think we do because I think they drive the wealth and they contribute to defining the need and they may or may not be on the Net.

PAYNE: And then sometimes they evolve on the Net.

BRAND: Many are. Some aren't.

PAYNE: I mean, you know, a few years ago like hardly anybody over the age of 30, 35, was on Face Book. Now you've got forties and fifties or even older, you know. In fact the young kids are getting pissed off. [Chuckles]

BLOUNT: Uh-huh. Cool.

PAYNE: Yeah. And so, but that's also another way to reach that crowd that wasn't available probably before.

GRAY: I've heard the discussion, the dilemma of do I "friend" my grandfather?

VELOSA: Yeah, I just recently friended my dad.

SAFFO: Can we set up a competition? I mean, instead of scanning outwards --

VELOSA: Oh, kind of like the End of Oil but --

SAFFO: -- can we create an attraction.

Transcripts were not edited.

GRAY: That would be –

GOLDHAMMER: Describe a little bit more what that looks like.

BLOUNT: And it'll look like an X-Prize?

SAFFO: I don't know. Well, I mean, we have -- if it works for DARPA, it should work for us.

PAYNE: We discussed that at the beginning of this committee.

GRAY: Yeah, yeah.

PAYNE: That was one of the earlier discussions, how we got people, incentivized people to participate.

VELOSA: But actually, Paul, I would want to hear --

Payne: But it didn't work out.

VELOSA: -- to hear a question. I would expand on that a little more 'cause I mean, like that doesn't really seem --

SAFFO: Well rather than a grand challenge, a whole bunch of little mini-challenges, depending on the question asked, you create a different fictitious organization to attract ideas. And you pay more attention to who brings -- you could use this a different way. So, one, you could use it to prequalify the folks who should be in the workshops.

GRAY: So you have kind of that crowd, that crowd-source competition, and then within that --

SAFFO: So you're looking for --

GRAY: -- you identify --

SAFFO: -- you're looking for elites within the crowd, which is where I think what we want are the hidden elites in the crowd.

GRAY: And you don't bias by educational factors or any other factor.

LONG: I mean, you know, it's my experience that's kind of like [..?..] –

[Simultaneous comments]

SAFFO: Yeah, intellect versus education. I'll take intellect.

LONG: -- so I have a strong bias towards undergrads. They actually, they're smarter and they get their work done. [General laughter]

VELOSA: If they're into it, yeah.

Transcripts were not edited.

GRAY: If they follow the system instead of trying to fix it.

SAFFO: I have one Ph.D. student who's four years late on his paper. So to do that and then to also frame questions. I mean, because I really think this is about figuring out what the right question to ask is and then finding the right people to answer it. So can we create, you know, a honey pot that attracts that.

GRAY: So maybe we use experts and generalists to identify areas and then use those areas to then ask the question of what are the questions in this area, what are the big --

SAFFO: I don't know, if there's a way. I mean, it kind of gets down to the specific, is there a way to make it even more concealed and, you know, think about a gaming company asking questions, giving out prizes, cell phones. That would bother Harry but – only Windows cell phones. Anyway, so that's as far as the idea -- I mean, it's an unformed thing. But what I'm trying to think about is rather than the mechanism that seeks and filters is to set up a lightening rod that attracts the ideas and people. It's a lot easier to sit back and let them come to us.

SAFFO: And one way to –

[Simultaneous comments]

BRAND: We really need another anomaly detection. The peculiar thing about anomalies is you've got to know what everybody thinks that you'll find out what's different than that, so some form of indicating the conventional wisdom or the official future, as we call it in the scenario business, even though it's outside that.

VELOSA: I think that should be a central foundation. We need to know what we know so we can start looking for what we don't know that we don't know.

SAFFO: Well actually, I think it's easier than that. You know, in our business looking for wildcards, surprises, whatever, it's just cultivating a proper sense of the weird. So like the one I've been obsessing over for the last ten days was there was a helicopter, police helicopter shot down over a large city recently. It was not Bagdad and it was not Kabul.

GRAY: It was L.A., wasn't it?

SAFFO: Rio de Janeiro. And as far as they can tell it was – a army gun. You know, it's one of them 50-caliber long gun things that the snipers use apparently. So my hypothesis is this is the new man pad. You don't need a shoulder-mounted missile anymore. You just need a fine piece of military technology. And can you imagine the look of surprise on the face of the three police officers in that helicopter as they went down, because that wasn't in their contract, that they'd be shot down by someone. But anyway, just an example. What I do when I look for – things that are weird just instantly get my attention and they keep rolling around. I actually think anomaly detection might be team based, a small team, choosing a network, pulling people in and then nose out, start asking questions.

GOLDHAMMER: Yeah.

GRAY: Would that be like specialty-based teams so you, so --

SAFFO: You could do it as a specialty team. I think you could leverage the Web here and do -- You know, in Harry's world, the cheesy part of Harry's world that he doesn't really touch is –

BLOUNT: [Laughter] Thank you, Paul.

SAFFO: No, but the, you know, the stock gossip lists in Yahoo Finance, you know, all the folks who sit there obsessed about one dumb little company and every time it sneezes they all go, "What's the stock going to do?" Is just have little -- if you could get groups of people having conversations around things and have some way to monitor it, pull out the stuff that seems weird.

BRAND: Just make an entry for it on Wikipedia and assemble your group around the ongoing definition of the weirdness and you've got it.

SAFFO: Brilliant. We can go home now.

VELOSA: Actually that, but I mean, as one tool, that would actually be I think an important element to start doing things, just, you know, some sort of exceptions analysis on Wikipedia, you know, that multiple audiences. So there should be of course the internal version but Wikipedia --

BLOUNT: Essentially it's the anti-Google. Anomaly processing is the anti-Google, right? Because Google searches the most likely outcomes.

BLOUNT: Right.

SAFFO: Well, right, instead of the "I'm Feeling Lucky" button, it's the "I'm Unlucky" button.

GRAY: Yeah, "I'm Feeling Unlucky".

BLOUNT: Exactly. The "I'm Unlucky" button. [Chuckles]

BRAND: It's all Minority Report, isn't it?

SAFFO: One tool we really could use, I think something that would, especially for exceptions but across the board, is to factor into our system, when we actually get robust, image recognition and decoding so when we do a

Transcripts were not edited.

visual search on the Web, searching images, my hunch is that's a lot more useful to us than searching text.

BRAND: You find amazing stuff with key words.

GRAY: The AP has a section for the weird stories and, you know, or the strange stories, and I read that religiously because it's – one, it's funny and, two, it's very informative because people come up with the strangest things to do this stuff and you usually find it there.

GOLDHAMMER: So I've heard, I mean, just in terms of information that gets collected, I've heard Web-based information gets collected, I've heard sort of workshops, I've heard people inside, outside the United States, young people, people educated, not educated, poor, rich. Any sort of organizing thoughts on sort of what that comes down to in this first version of the system?

VELOSA: Well Paul had a an idea.

SAFFO: No, go ahead.

VELOSA: Okay. Well one thing actually, maybe it's a precursor to that or as a response to that, it sounds like the things we've been talking about are a little bit on the presence mode. Does this have to factor that into all those, the future mode as well as in applying, you know, a variety of levels of intelligence? And I don't know – and by essentially I mean actually just people, you know, eyes on the data stream. So one of the things to me is to make sure that as part of the persistence we actually have a cadre of folks just continuously looking at it and then tweaking it.

CULPEPPER: Like a users group essentially.

[Simultaneous comments]

BRAND: A users group is like that. I mean you!

VELOSA: Yeah. You have to have a set of folks. And then have assorted users.

BLOUNT: The only thing that worries me about the term "users", it almost means you're by definition including people that have a common interest, something which is more of a bias. So if the concept is a feedback loop, your original premise, then that makes sense to me. But then the question is how do you create the feedback loop that doesn't have some major inherent bias in the user groups?

VONOG: But if you have a user group of people forecasting the future, then there is no bias. Like you could imagine people gathering just who are interested too.

GRAY: Is there a disruptive technologies blog or, you know, or interactive space?

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VONOG: Well, I mean, I could imagine like TED is sort of, they have TED events all over the world.

GOLDHAMMER: There are.

BLOUNT: I mean, you know, that's the –

[Simultaneous comments]

GRAY: -- [..?..], you know, or you could call it a futurist or something like that.

LONG: I'm worried about creating a high Q echo chamber here.

BLOUNT: Well, so here, but here's where I'm going, is in the financial markets you have massive and immediate feedback, either amplifying or dampening, because as an analyst we put out a report that has a thesis on it and it's a constructive narrative on why we think our thesis is right. And it's amazing how quickly I got calls who said, "You're full of garbage, basically, on this and here's the reasons why." So essentially what you want is to essentially have something that stimulates that type of reaction so you get the feedback loop that's immediate and fast. So the question is, is it almost speaks to needing some kind of broadcast of the narrative to a group that somehow or other is incented to respond and it doesn't have to be monetary incentive and maybe it goes to Paul's comment about this grand challenge of being provocative in a heretic is a very creative way of getting a rapid, strong response that's broad based.

SAFFO: And let's – I have a name for it. Let's call it TIA, Total Information Awareness.

[General laughter]

GRAY: But that's interesting because by using that approach to stimulate the response, you could very quickly then pull out where are the pragmatists and where are the tails.

BLOUNT: And if you iterate it, you create your own centralized mask that then causes further and further, you know, the ball dropping --

PAYNE: So you need kind of like stewards to kind of put that provocative issue out there. And the good thing about that too is that when people really want to put you down they'll try and bring the evidence in, you know, to prove their point. And then those folks who agree with you are going to bring their evidence in to prove your point. It may not be what you put down as part of your evidence. Maybe new people in there. So I think one of the things -- and we kind advocate, you know. I think stewards or something to that nature or some of those folks that kind of stoke the fire or keep the flames going are really important in that type of situation. And it's not the answer but, you know, as far as you trying to get feedback on certain things.

Transcripts were not edited.

LONG: So what I've noticed here with what we're saying is to get this reaction that you want, people to notice that, you have to challenge them, you have to be adversarial, right? If these guys agreed with your analysis they don't call you and say, "I agree with your thesis. It's wonderful." Right?

GOLDHAMMER: Not often. [Laughter]

LONG: You get the phone call from the people that say you're full of crap, right? And similarly, when you're doing an analysis of technology or whatever, if you do things that confirm people's biases and opinions they go, "Oh, yeah, that's very nice, okay, good," and then just continue their own way. But when you go and you gore their ox, you're going to get a reaction. And I think that's – you need to build something into the system that's going, you want to, to get those people --

BRAND: Yeah. It's called top covers. [Laughter] [..?..]…

[simultaneous comments]

LONG: You want those guys to react. You want them to react because otherwise people are going to be passive and just let things go. You know, we're all very busy and if you confirm my biases I'm fine. Just let that go, right? It's when you say something that says that I'm wrong, oh, boy, then that's when I react.

PAYNE: But it's not a bad idea to have the things that you actually believe that may be institutional knowledge because you'll get the outliers coming there too. I mean, how many times have you read an article that seems benign in the paper and then you read the blogs afterwards and there's these people coming from way out like whoa, you know. And sometimes, so when you do like the party line or whatever, you know, you'll get some antagonists as well and get thoughts that you didn't think about.

LONG: But those guys usually get, in my experience, those guys get ignored, right?

PAYNE: Right, but we don't want to ignore them.

LONG: It's go along and get along.

PAYNE: Right. But we don't want to ignore them though. We want to pay attention to them.

LONG: Right, but that's not the way we do things now.

PAYNE: We want to change that.

LONG: Yeah, exactly.

Transcripts were not edited.

BRAND: What's the role of demos here? I mean, I worked in the media lab for a while and deal with this demo We're talking about technologies, new technologies, emerging technologies, potential threat aspect of these things. You know, red teams do one thing. But to actually – there's lots of things it turns out you can't make a demo of it. It's probably not actually a threat or it can't be until these other things that you've now identified come in to be part of the tool. So, you know, to succeed and fail in making demos of various things that one emerges with, if you get a successful demo, that you can take into somebody's office and they know it's impossible and you show them it works, then fuck, they've got to deal with that. So is demoing part of this process and, plus, it'd be fun.

LONG: I think that's a form of hypothesis testing, right?

BRAND: It is a form of hypothesis.

SAFFO: Well you know, in fact you could argue that the attack on 9/11 wasn't an attack, it was a demo.

GRAY: Uh-huh.

SAFFO: Because it really didn't kill that many people. But it was such a convincing demo they didn't have to do the real thing.

BRAND: The problem was the design was, it was a one-off. [Chuckles] You only got to do the demo and nothing else.

SAFFO: But it was a really good demo.

BRAND: Yeah, great demo. Once.

CULPEPPER: You know, as I listen to this I think about marketing and go-to-market type structures and a lot of times if you put out a press release in a business you do it, you're doing it because it's bait. What you really want is you want the media to respond to it and then carry your message, right? And you send these things out in varying kind of methodical cadences over time and you get, you start to get reflections back from the market, you know, from other people in the market, on the messages that you sent out. And that's when you know that you've kind of hit a qualitative point of return like okay, you know, that message stuck and now let's move on to the next message. And as I think about kind of what Darrell was saying on something provocative that evokes a response, it's almost like the tool's got to have some mechanism to send out these, to launch these little missiles out there that kind of immediately engender that kind of like bang, and develop it in such a way that it's got a cadence to it over time so that you're constantly testing, bouncing an idea, making sure that you're getting that response, right? 'Cause the response isn't going to come at you immediately. Sometimes it takes months, you know, but it will come if it's got the right content and message to it.

Transcripts were not edited.

GOLDHAMMER: One of the things that’s interesting about this part of the discussion is it seems like there’s almost a debate between to what extent do you intervene in the big system in which disruptive technologies are being conceived and developed, to what extent are you a passive observer of that system where you’re passively collecting information about it and seeing who’s doing what but you’re not really pinging the system. Those are very different models, it seems to me. I’ve for some instinctual reason feel like that pinging the system, it becomes very difficult to know whether you’re observing effects that are sort of native that you didn't have an impact on or whether you actually caused the thing -- You know, the Heisenberg’s principle: Are you causing the thing that you’re actually looking at.

BRAND: Especially if you ping it in paranoid mode.

GOLDHAMMER: Yes, especially if you ping it in paranoid mode.

CULPEPPER: Well I think though that there’s, you know, from the standpoint of communication and messaging and how you got the responses back, typically they’re latent. They’re there. They’re just beneath the surface. And when you put something out there what happens is people respond to it because it’s already on their mind. It’s been something that’s been kind of like just kind of right beneath their skin. It’s been bothering them for a while and then, boom, that was the trigger that like got it out, you know. So you think about existing, you know, the market that I work in, the energy market, I mean, the thing I would want to find out for disruptive technologies is, you know, put out a message that says, you know, "Monopolies are a great thing and they really do great things for everybody and let me tell you how great it is," and see what response you get, 'cause I guarantee you’re going to get a response. And you'll probably hear it in very subtle ways. Sometimes you’ll hear it in very loud ways. But those are kind of the trigger points on the edges that you want to be able to look at and go okay, who reacted to that and why.

GRAY: I think maybe what you want to look at is kind of a balance of the two, where you have part of the system that is simply asking the question and getting a – you know, in effect a list from the experts or the generalists and say here’s what we think are important. Then you take maybe some input from there, use it to seed, to try to find the outliers, you know, the --

CULPEPPER: It’s a sonar, passive and active sonar.

GRAY: Yeah, the people who are not responding in the normal are not part of the normal routes of generating that type of input. It’s funny because in the technology side you see this where you have engineering design competitions and they say, “We want this. Go forth and build one for us.” Like we saw a presentation about building a torpedo from, you know, common objects. And then the other side, you have like the Case-Coulter Initiative where – Case Western – where they just want innovative technologies. They don’t necessarily give a lot of -- Their

Transcripts were not edited.

guidance says I want an innovative technology that's going to be, you know, good for people and have a clinical use. And that's it. And then they get, you know, 25 ideas and then they go through those and find out what's viable. Now you can make an argument that from there the tech transfer system fails but at least from the innovation side, they do both pieces. They have directed innovation and then they have kind of open-ended innovation.

VELOSA: And I really like actually what you guys have been saying so far because in terms of going back to the weak signals, it's one of those where, you know, it'd be really interesting to do that kind of active/passive sonar. I think that's a great analogy to be using. But the other thing is to actually then do these competitions and, for example, one of the things would be to set up so you get different educational levels. For example, get -- I mean, like all undergrads usually in orientation have to – in engineering school, sorry – have to go build, you know, drop and egg without breaking it, right, you know, the usual kind of thing. But maybe you'd do something in particular towards find some high schools or alternatively, get new recruits in the Army or something, you know, get a population with just high school, a population with college, you know, and try in different locations with some of these signal kind of sensors. So you do both the competition as well as the passive/active sonar.

GRAY: It's interesting because the systems biology world came up with this international systems biology competition and their idea was, you know, you have to come up and do these things. The problem was to some degree they were snobs about it and they opened it up to university campuses. Well, what about people who do this in their garage that are 13? You know, that's who we want to talk to. We want to talk to that 13-year-old that made it in his garage not the 25-year-old graduate student who's well on his way to a Ph.D.

CULPEPPER: You know, one of the things that I've noticed about disruptive technologies and people who are involved in it is they have – they're disruptive and that's the nature of who they are. They like to be disruptive. And if you put a message out, it is going to come back at you, you know.

[laughter]

PAYNE: Yeah, but sometimes, you know, there's something to be said about naïveté. And that's the other people that are disruptive, that they don't know that they can't do that.

GRAY: Absolutely.

PAYNE: They don't know that it's not possible and so they move right ahead because nothing is encumbering them, you know, intellectually from stopping -- you know, Al brought up a good point. You know, if you have too much education, you learn too much about what's not supposed to be and what you can't do.

Transcripts were not edited.

BLOUNT: We run something every year at the Tech Museum called the Tech Challenge for grades 4 through 12 and it's a real-world problem. Last year it was landing a scientific package in a volcano. This year it's about space jumping. And we also give out an award, by the way, for the most spectacular failure. We want to encourage the failures. But if you go and observe this, the creativity for opportunities to disrupt and these common thoughts., is actually staggering.

VONOG: Uh-huh. So maybe it's an input from the system because there are lots of these competitions going on. Those that I have participated called the Imagine Cup, which is 300,000 students all over the world for Microsoft. You just take a brochure of worldwide finals, it's like – and kind of see what – flip through countries and you can see like all the problems that are interesting. And the topic there is like eight problems that UNESCO thinks are most important or like imagine worldwide technology just bounded. And I'm sure there is like for biotech, or like children's things, so there is a compilation of a list of those competitions.

SAFFO: And for small scholarship awards.

VELOSA: I'm sorry. Keep that -- Can you just make sure you write down that one of the things we should --

GOLDHAMMER: Competitions.

VELOSA: -- you should do is have them, yeah, survey all competitions to see what they are doing.

[Simultaneous comments]

GOLDHAMMER: There's a competition data set.

VELOSA: Oh, there is?

VONOG: Yeah, and it's free, like --

GOLDHAMMER: It's a great one.

GRAY: Well I mean, there's a -- The Learning Channel actually has something for grade schoolers that I've been interested in 'cause my daughter's five and a half.

VONOG: And maybe you have a scout, like in the Imagine Cup they have demos, worldwide finals and all.

GOLDHAMMER: Yeah. There are two sides to this and I feel like the conversation – and I think we've touched on one side of it, which is technology creation, competitions that are getting people to do things in new ways. What about the use and adaptation part of the story?

Transcripts were not edited.

VONOG: Well, in those competitions it's part creation, part user adaptation. There is, people are doing all kinds of things.

GOLDHAMMER: Yep, that's fair.

SAFFO: It's a narrow thing but it would be interesting to broaden out, is follow volume and pricing of key technologies on eBay.

GOLDHAMMER: Yeah, yeah.

UNKNOWN: That's a good idea.

SAFFO: So last two years I've been following the price of thermo cyclers on eBay as an indicator about bio-hackers at home.

BRAND: Oh, that's interesting.

VONOG: Well that's kind of – Gilman was talking about measurements like bandwidth or --

VELOSA: There's a way to track it?

SAFFO: Oh, you just, I just go up there about once a week and I -- There are not a lot of thermo cyclers so…

VELOSA: Oh, okay. Okay.

GRAY: But you've got actually – that's a really good point because as labs are closing down all over and this stuff is hitting the market – again it goes back to the waste stream. And this is a biological waste stream of stuff that's not 25 years old, it's five years old or less.

SAFFO: And you can take it a step further. It never really occurred to me to send an email to somebody who just bought a thermo cycler but it would be really interesting to follow up.

GOLDHAMMER: Yeah, with the guys in the suits who knock on the door. [Knocking noise] "Scuse me."

[Simultaneous comments]

GOLDHAMMER: "We're here from the government, we're here to help."

GRAY: Yeah. [General laughter]

SAFFO: Please. That happened to me when I was 12 years old and I still remember it.

CULPEPPER: Well I think that's exactly the kind of passive structure that's really strong, right?

Transcripts were not edited.

GRAY: Right.

CULPEPPER: It’s very scalable. I mean, like that kind of system is like you can ramp that up very, very quickly, you know.

GRAY: I’ve been following the do-it-yourself biology blog.

BRAND: Good. What do you find there?

GRAY: It’s interesting that people are doing just what we’re talking about. Somebody posted instructions on how to make a biological fume hood. You know, somebody else said, "Here’s how you make –" you know, some other piece of equipment and it’s being made out of everyday materials.

BRAND: I know the guys behind that blog and it’s pretty interesting stuff.

GRAY: Yeah, it’s interesting but it’s also a tad bit scary, you know.

BRAND: Well, what they’re doing is basically adding to what MIT is doing with the iTune meetings and so on and saying, "Look, we’re leaving the amateurs out of this and the amateurs are going to be in it anyway so let’s work with them."

GRAY: Uh-huh. Well, and as I was talking with Ken, one of the things that you’re getting now is a bunch of disgruntled post-docs who are no longer in the academic hierarchy, you know.

BRAND: Is that right? Oooh.

GRAY: And so what do you do when you go and become a drywaller or you go and become, you know, a business guy because there’s no career path for you in academia anymore but you still love science? There’s where you’re tracking–

[Simultaneous comments]

BRAND: Okay, so the disgruntled post-docs is a population of great interest to this group, it sounds like, and they’re findable, I assume.

GRAY: Well they’ve, they have, in the last five years you’ve trained about 25 times more post-docs than the system could feasibly use.

BRAND: How many of those are going to a home country which is not the U.S.?

GRAY: Not a lot.

BRAND: Okay.

GOLDHAMMER: So lots of different classes. What about information processing? So we talked a bunch about information that needs to be collected, different ways in which it gets collected. I think we can kind of capture some of that stuff on the table. How do you make sense of it? Is it, you know, is there a central, a coordinating function to this whole thing which has kind of an analytic component to it? Are there different analytic teams? Like who’s looking at this stuff and saying like "That matters, that doesn't matter, that matters, that doesn't matter"?

PAYNE: Well, and I’m not sure how a basic system is but some of the folks who’ve been on a committee – talk about building something about defense technology in one system. And part of that is you have 20 technologies to work in, 20 different disciplines. And for our office they’re supposed to be the ones to do that. How we would do that – and we would like to do that for the, you know, DOD, DDR&E because we have the same interests, you know, from the intel perspective we’re just worried about innovation really and use, you know, from that threat. But our interests are similar, more out to the, you know, Department of Defense, DDR&E(folks who are doing the research and engineering). And so it kind of can cross both ways, you know. That’s how we do it but that’s not --

GOLDHAMMER: Right.

PAYNE: But I kind of want that problem solved within this group without that information.

GOLDHAMMER: Okay. Forget you just heard that.

PAYNE: No, but, well some of the folks, the committee members have heard that and so I kind of would like to see that resolved outside of that, where you would develop a system that does that. I mean, maybe you do have some technology stewards. Maybe it’s not 20, but where do you get them and how do they operate within that, the hierarchy?

BRAND: That’s one example. What are other exemplars of this kind of process?

VELOSA: Well, but the other thing though is it’s technology, right? I mean, what about use 'cause to some extent it’s actually – that’s more relevant 'cause the IED was not a technology, it was a use. So it’s just like is there a way to have use or --

GRAY: I think you might be able to address that by targeted competitions.

VELOSA: Oh, through the …

GRAY: I think if you were to challenge people, you know, kind of like the Navy did, well make a torpedo out of common things. Well how did they do it? What did they do it with? And so you simply say, you know, given what you can scrounge or buy for and maybe put a dollar on it, say you can't spend more than $200 to do something or a hundred dollars to do something and then kind of, you know, address, you know, give them targets. And you could have either a physical contest and they have to

Transcripts were not edited.

build it or they just frame it out and send you a sketch on it, you know, and their idea. I mean, it's one or the other.

BLOUNT: So it's like a design challenge, learning it. You could almost use Amazon's mechanical platform to facilitate something like that.

GOLDHAMMER: In my experience I find creating almost just sort of a mini version of the kind of diversity perspective that you're hoping to see globally and doing that with your analytic team, it could be quite powerful. So you've got, you know, you've got the systems biologist, you've got political scientists, you've got intel people, you've got basically a huge cross-section of different people who are trained in different ways but the basic purpose is to look at the data that's being collected, a lot of the data that we've just discussed, and figure out what it means and why it matters.

LONG: You guys just said something that actually worried me a little bit and that is we'll have these competitions and we'll get people to try stuff. A lot of the stuff I'd rather that we didn't give them the idea.

GRAY: There's an argument that way.

LONG: So there was this guy in New Zealand --

GRAY: Yes, there's an argument that way as well.

LONG: -- a few years ago that – he was a very interesting guy. He was all into pulse jets and he was going to make a cruise missile for $10,000. Fortunately, I think he was discouraged from this, okay?

[laughter]

LONG: But, you know, I would rather not encourage these guys to do this. What I want to do --

PAYNE: But --

LONG: Hold on a second. I need to figure out if people are going to do this but I don't want to seed ideas to adversaries --

PAYNE: Right.

LONG: -- is what I'm a little bit worried about. So let's have a cruise missile competition, shall we? You have $500 to build a cruise missile. I'd rather not do that.

VELOSA: But you could have the competition inside, you know. I mean, just have --

GRAY: Yeah, that's fine. The Academies are wonderful for those kinds of things.

VELOSA: Well, but my point is actually get away from the Academies. Go to the enlisted folks 'cause again, you're --

GRAY: Yeah, the enlisted guys do great stuff. Like for example, one of the IED defeat things was done by an enlisted or I think it was a sergeant, right? And what it was, it was a heated plate on the end of a long arm.

BLOUNT: You know, the only thing I worry about with that though is maybe if we don't put it out there it will go away and --

SAFFO: Well the people to consult. This is a problem that's faced by police departments all the time. In fact, there's a case moving up to the Supreme Court about entrapment as we speak. So I think it's just a design detail that one has to come up with criteria about what are the safe and proper things to encourage. I mean, forget cultivating terrorists. I mean, this really is the TIA outcome where you don't want to create something that's a political hot potato. But that can be a design element, that's a design problem. So if I put a box in here, you know, there's a risk/benefits test to everything that's done.

PAYNE: I think some of the things too when you look at this, as you gather information, whichever way you gather it, you know, is -- And Harry, how would you sort through that to figure out what to invest in? How would you sort through that data and say this is a disruptive technology that I want to get ahead of and I want to be the first or one of the earliest ones to put my money towards that? I mean, how would you sort that data out to make that decision?

GOLDHAMMER: That's a key question.

GRAY: I think Stan had a good idea earlier and that was I think we've identified kind of this top, at this point we've identified kind of the top two pieces to get things to then be in a list of actionable or analyzable topics now and maybe we've identified, you know, weak signals, strong signals. So now what does that analytical piece look like? Is it a, you know, a science component, is it a finance component, is it a political science component, you know, do we have pieces that feed this and is it, you know, rank, you know, front ranking, is it a feasibility ranking or how do we go through that?

BLOUNT: Uh-huh. In answer to your question directly, this is a true case example. When I was covering technologies, hard drives, I put out a thesis. I had the call on hard drives for years and all of a sudden I got this phone call saying, "If you're not thinking about this, you're nuts, you're missing the whole point." And the word was residuum, which was a word I hadn't heard since high school physics. That was a weak signal and all of a sudden I had to make a bunch of phone calls. And it quickly became apparent that -- and so one of the key criteria here is I knew who my customer base was and what was important in terms of impact. A few phone calls it showed up that the company that had been thoughtful about securing the control over residuum had a significant margin advantage, profit margin advantage for a number of years. They controlled the supply chain. And then I was able as an expert to assess

Transcripts were not edited.

the impact and go back to my stakeholders and say, "We need to buy the stock because…" So I think as a design criteria it is, once you have the signal filtering mechanism, is the people that understand the stakeholders' impact lens or filter, whatever it is.

SAFFO: Who? Go ahead. Who was the company?

BLOUNT: Seagate.

SAFFO: It was Seagate.

BLOUNT: It was a byproduct of the gold manufacturing process. Who would have thought? I mean, there's like three people in the world that knew --

GOLDHAMMER: But that was also a trigger for you to go ahead and make those phone calls.

BLOUNT: It was the weak signal. It was a word I hadn't heard in twenty years.

GOLDHAMMER: But the question is how do you design a system so that Harry Blount is the one who's looking at the weak signal and actually recognizes it as a weak signal as opposed to me, or any one else.

[Simultaneous comments]

SAFFO: Harry is a spider at the center of this vast global Web and he feels the little vibrations coming to --

VELOSA: Yeah, and part of the point you said has to emphasized because it's Harry Blount who people pay attention to because he's demonstrated relevance before, right?

GOLDHAMMER: That's right.

VELOSA: You have to have folks that are, can take a weak signal and then get listened to as they come out --

GOLDHAMMER: Well here's a totally radical proposition, just to follow on that point, which is what if V.2 of the systems is not about identifying disruptive technologies? What's the low, I mean, is there the so-called low-hanging fruit in the disruptive technologies space and is the first version of a system just simply optimized for identifying the disruptions in X so that you can establish that credibility and you can actually start building out from disruptions in hard drives, disruptions in telecommunication devices, disruptions in something actually quite specific, and then build out from there? You actually develop the model not around broad disruptive technologies but something very specific.

BRAND: That would take very intelligent systems growth because typically when something becomes expert something early on, that sticks with -- It took a long time before there were any biologists on the Jasons, as I remember, going all the way back in its history. And that lapse like showed. Any of these things, you want the work-around. One I'm trying to think of a work-around on is best way to get good analysis and good judgment is to have a brilliant fucking leader and, you know, you go through the process. Usually you've got a brilliant fucking leader and you keep him or her and all the rest of it. And if they go away – [loud laughter in background]…process. Great. But all brilliant fucking leaders have blind spots which can kill you, depending on how -- they're really, really brilliant, they're totally persuasive, they've got all this fantastic record to show you how great they are and everybody's in awe, you know. "I'm a Rick Oliver et al" or whoever, but there's blind spots. So here's the design problem. With the collusion perhaps of this brilliant fucking leader, do we have blind spot analysis and action so that it doesn't become the thing that trips you up? I don't know the answer to that but it's what I would want to do with something that depended on good judgment.

GRAY: Maybe we need to identify the, you know, the professional communicator. Because we've talked a lot about how to communicate this to the eventual customer and knowing your customer. So maybe it's we have an analytical piece that then feeds this front person who then has the credibility to bring the information out. And, you know, if you have, say, five or six functional areas that are, you know, we came up with – we identified some signals, we identified some populations and got some big questions and we brought it down and this group of five or six areas worked on it and then you turn around and you feed it forward to somebody who is the presenter. And that's, and to some degree you might want them – I know this sounds funny, but you might want them blinded to the process of how they got that information. Because one thing that might kill you is when the questions are being asked, you know, I don't want to use culpable deniability but I'll just say it might not be a bad idea to keep what happens behind the curtain behind the curtain, you know.

BLOUNT: I guess the question is, from a design standpoint, do we start by saying with the stakeholders and whoever the platform is what is -- an assessment algorithm, basically, what is the threshold level of, if it hits this many people or it hits this type of criteria, you know, it tends to resurface much more readily. I'm putting that out there as a question. In my world it was stock impact, you know, market cap – sorry, Paul. What's a better word for that, market, market effects? Sizing market effects. And so in your case, you know, if I asked you --

PAYNE: Once we see the effects, it's too late. [Laughter]

BLOUNT: Yeah, but there's a high level question, which is how do you – what's important to you in really having it in a thoughtful threshold so that when those weak signals come up there's some kind of --

LONG: No, offense, guys, but I think we're becoming a little too reactive here. We're talking about, you know, deriving things from signals and things like that and I think then we're behind the curve on this. You know, Stan brought this up and other people have brought this up, that we need hypothesis generation for something to happen, right? People need to be coming up with -- well, you know, you're talking about technologies, right? What happens if a disruptive technology happens in hard drives or communication or whatever? That's very nice and I'm very happy for that technology. But as I said earlier, it's the use of that technology, putting together a couple of things that make the real big transition. And we want to be ahead of that transition. We don't want to notice that transition as it happens. We want somebody to have said, "Well, you know, if – I want to do this, you know, some thing," right, and could we do that, make this hypothesis? And then you have other people that are gathering data and looking at this and saying it's possible for this to happen but in order for this to happen these things have to happen and then you watch those things.

SAFFO: So we have – at Longnow there's something that kind of works here. It's I think – it's a variation on prediction markets but I actually don't like prediction markets. I think the whole idea is cockeyed. It's called long bets, where, you know, if just one person wants to do it it's a prediction but if you have two people with opposing points of view, they go on record and -- Well, you should describe it.

BRAND: All I wanted was accountable predictions in the world 'cause I'm tired of going to all these conferences where guys wave their hands and say in ten years' time hard drives will, whatever the hell it is, and everything, and –

VONOG: Gilman has a portfolio company, by the way, who --

BRAND: I'm sorry?

VONOG: Gilman has a portfolio company, by the way, who sold accountable predictions inside like big organizations so…

BRAND: Right.

LONG: What is an accountable prediction?

BRAND: An accountable prediction is a person's name on a falsifiable statement about something that will or will not happen by a certain time in the future and their argument --

LONG: And their ranking goes up or down based on their ?

BLOUNT: -- their argument about – their theory of the world that makes that particular thing come to pass or not come to pass. And the accountability is that this is kept online, it's voted on, it's argued about and then the time comes to pass and it happened or didn't happen. That's all.

Transcripts were not edited.

CULPEPPER: Yeah. No, I think that's one of the best tools out there like for exactly what you're talking about.

BRAND: Sorry?

CULPEPPER: I think it's one of the best tools out there that I've seen, actually.

BRAND: Thank you.

CULPEPPER: That long bets are exactly –

BRAND: Use it more.

CULPEPPER: That's it.

BRAND: Martin Reese has one and nobody's taking the other side. I think he said there'll be a million people that die from an instance of bio-terror or bio-error by 2030 or something like that.

VONOG: I had a small point about the anomaly detection. So just I think it's useful to assume it's a solvable problem within like short period of time because, first, like an anomaly is an outlier in some set of coordinates. And second, I know like a few companies who are working on kind of that stuff, like -- And third, like just as I'm thinking, if I could design the system like you will get sort of like startups tech crunch. You have this Web, Web, Web, Web, Web application or tech crunch like you have like 50 Web application and then you have like one sort of iPhone controller thing. So that's like already some kind of an outlier and it's not like a prediction but you could have some automatic prediction built pretty easily. And a second point about – so Gilman's company, they are doing – So the guy, the founder, worked at EA, it's a big company, and they kind of making this prediction when product is going to ship and how much users will use it. And they're wrong all the time. And he found out like if you talk on a soccer field to different people you can be so much more accurate in those predictions. So he left EA and started this company where like he sells to enterprise and they make bets and that kind of system makes much better prediction. They're 60% more. But that's like short-term thing, not long term, not ten year.

PAYNE: Well, Stan, when you started the first(?) company --

GOLDHAMMER: Well let me suggest that we --

PAYNE: No, I was asking Stan, like, you know, he started his first company and how old were you when you first started your first company?

VONOG: 23.

PAYNE: Yeah, and so what was your thought process to say here's what I want to do. I want to start this company to do X. What drove you to that.

Transcripts were not edited.

VONOG: Yeah, in my case it was kind of -- So I was participating in these competitions and then in 2005 we won with this music thing when we imagined worldwide technology causes boundaries between people and we want it. And like why not start the company?

GOLDHAMMER: Why don't we get up and move over to our table and get our blood circulating.

[Move to project table]

[General conversation]

PAYNE: Sometimes it's the question that's asked. You know, we're asking a really big question. Hey, solve all these things, right, where we can say, "Hey, how would we find out if somebody is developing X?" and then we could go right down sat, okay? We could go right down the slot.

GOLDHAMMER: Word for word.

PAYNE: And so we realize we're asking this difficult question, we do, and so maybe we can narrow it down to technology, I don't know. I don't know. physical science or basic to whatever. That's why you get so many divergent things like here's where we are. We know we're doing that.

GOLDHAMMER: You know, whether it's one technology or a bunch of technologies, it's primarily a systems problem and the thing about systems problems is there are a million different places you can cut into a systems problem and you're looking at the system from every different angle. So we talk about collection, we talk about analysis, we talk about different ways to support. All that's required. But what's hard to do with in groups like this is how to do, sort of think through systematically like what are the actual, what are the priorities. But a lot of the conversation…

[Simultaneous comments]

PAYNE: And don't concentrate on intelligence. We're at the very tail, we're at the very tail end. All these innovations have happened by the time we really, all these technologies and science have happened by the time we're willing to something. 'Cause now we're concerned about, you know, why would somebody want to do something against us and then, you know, what will be their expertise or what do they have available to them, all these other things. So we're looking at other things by the time it gets to us technology-wise. And so that's why from the DDR&E's perspective we want to know this technology so we can get out in front of it so we can develop things. And so -- And that's why I'm not -- That word about use drives

[Simultaneous comments]

PAYNE: Right, and identifying, you know, what's going to drive technology and those things, and then we get -- it's funny. My boss has this thing like a -

- it's like a, he calls it the heater scale. You know, those old heater and air conditioning things?

GOLDHAMMER: Yeah.

PAYNE: You know, where it would be like blue at the beginning and then as you got towards the end it looked like more red. And so blue is the DOD and we're the red. And so like at the beginning of the phase over here on the left-hand side you've got all this blue and it's almost all blue the whole way and it slightly starts becoming red, red, red, and then down towards the end of that is the red part. That's where we get involved. So we're really trying to look at that first part of the blue part and then that's why it's open. I mean, by the time –

[Simultaneous comments]

GOLDHAMMER: So let me make a suggestion. I think this is the kind of thing that as much as I would love for it to be one single process, I think we should have a parallel process. Otherwise I don't think we're going -- I think we need to put a couple different stakes in the ground. And before we start writing up big things we probably should write on little things. So let me -- We've had a bunch of different conversations at the table about different elements of the system. What I'd like us to do is in a small group, a couple people, take some Post-It notes and start blocking out like how, you know, if you're interested in, if you think competition is really important from one part of this, either for collecting information or for processing information, what does that look like? If you think that's some other element that we've talked about, so, you know, like long bets is an important part of the system for surfacing the key issues that we need to look at, how does that look like? Who's making the decision about what the bets are, what is the process for making those bets, where does that output go? Let's sort of break this up into a couple of different pieces and then see if we can put it together. And I'm also open to other suggestions but it just seems to me that because it's a systems problem, everywhere we cut at this it just gets massive quickly.

UNKNOWN: I'm glad you said that 'cause it is a big problem.

GOLDHAMMER: It's a big massive thorny systems problem. So if there are no alternate suggestions, let me break pieces off and feel free to start doing some designing. Let's see if we can -- It might be widgets that we end up with and it might be a system we end up. We'll see. All right.

[Simultaneous comments]

GOLDHAMMER: And can I make also another suggestion? Let's just focus for the next 15 minutes or so on collections, different kinds of collections over on this side. This is going to be very hard to take that apart. I just apologize in advance.

UNKNOWN: I'm assuming you mean both passive and active?

Transcripts were not edited.

GOLDHAMMER: Both passive and active, exactly.

VELOSA: So you want data collection on any particular area or --

GOLDHAMMER: Yeah, well let's just --

GOLDHAMMER: -- on this side of the table?

GOLDHAMMER: On this side of the table let's do collections. We'll do analysis, we'll do narrative, we'll do reporting.

VELOSA: And I'm sorry, you want us to do big fonts?

GOLDHAMMER: Big fonts. Yeah, so let's just figure out what are the elements of the system. There are pens here if you guys want [..?..].

BLOUNT: So we just throw stuff down? Someone else is going to organize them?

GOLDHAMMER: Yeah, let's throw stuff down then we can talk about it. How does that happen? Who's doing it? That's what we want. The concept's great. How does it actually happen?

LONG: How about this?

LONG: We talked about this.

GOLDHAMMER: Can you block it out?

LONG: Can I block it? I have no idea what you're talking about.

GOLDHAMMER: In other words, can you show me what are the steps in the pro-, whose -- is some group generating questions, some group generating hypotheses?

LONG: Yeah.

GOLDHAMMER: Is it five groups, is it three groups?

LONG: How much money do you have?

GOLDHAMMER: You know, assume for the time being that, you know, it's finite.

LONG: Yeah, okay.

GOLDHAMMER: Okay?

LONG: All right. We'll scrap that.

CULPEPPER: So media tracking is basically, there are a number, not to be too technology centric here, but there are a number of systems out there that allow you to track qualitative and quantitative data and that's what that's

Transcripts were not edited.

about. That's basically a passive monitoring system, put it that way. One angle

[Simultaneous comments]

GOLDHAMMER: And is that purely computational?

BLOUNT: Yeah, that's literally looking at press releases, looking at what goes into a different media story, anything basically that has to do with it gets out into the public world. You know, odd stories, anything like that. Right? It's a purely quantitative passive collection.

GOLDHAMMER: All right. And capability tracking? This is -- tell me more about that.

BLOUNT: So basic things like, does somebody have the materials, the education, the money.

GOLDHAMMER: Okay, okay. Computational and human?

BLOUNT: Or it just could be access to raw materials.

GOLDHAMMER: Access to raw materials.

BLOUNT: So part of it is if you have a thesis, what are the requirements that are going to make that happen.

GOLDHAMMER: Okay. And money flows?

BLOUNT: Same thing. Follow the money.

GOLDHAMMER: Follow the money. Who's buying stuff on eBay, money flows?

CULPEPPER: So you include in that, Harry, kind of P&L, just any sort of money flows, capital flows, or down to a P&L at a company level?

BLOUNT: I think it's actually maybe even more basic than that, is following, like research grant flows, how -- You know, the first time you see a new flow of money into an area, that's an interesting data point. So it's probably, you probably want to -- what's more interesting is a new flow and then a rate of change in flows.

BRAND: And watch for a language, new terminology.

BLOUNT: Like the residuum within my lexicon.

BRAND: When hackers came up with a hackers' dictionary that was new

CULPEPPER: That's kind of what I'm talking when I say message program response. That's really exactly that kind of thought.

Transcripts were not edited.

GOLDHAMMER: Enthusiast tracking. I like, what I like about what we're doing here is it's not just tracking information but actually specific things that are getting tracked or enthusiasts, media, capability, the money. Say more about some of these, story generation, collaboration tools.

VONOG: So story generation was this direction of thought that when you start with a story and then develop data around it and think about the stakeholders first and how you sell it.

GRAY: Analysis.

VONOG: So then story generation comes. And collaboration tool, people who build networks, that's kind of when we talked about data overloads, how people deal with data overload now. You have like Twitter, Face Book, you just have like trusted people and you hide those which are noisy and you get less people. So this kind of social network tools to help get through that noise and overload. And data collection's just like I guess they can work

GOLDHAMMER: It sort of generically describes a lot of the other stuff.

VONOG: Most automatic stuff.

GOLDHAMMER: Okay. Irritators' diffusion rates. Can you say more?

BLOUNT: So diffusion rates is if you have disruption, a disruptive event might be easily diffusible across the globe or it might be very hard to diffuse it across the globe. It kind of gets into not only, it gets into not only collection but an impact. And irritators, this tends to be your outliers where you get the strongest reaction to polarization, what causes the polarization of event.

GOLDHAMMER: Okay. As you're looking at this, I'm also interested if you see ways to organize it, whether they're things you would do, whether there's priorities or the things you do first, things you do second, things you do third. And I'm interested in not actually – it's both adding to the list but also whether there's a way, whether you see ways in which we can organize the different things that we need to look at and to gather.

LONG: So you've driven the stake in the ground here --

GOLDHAMMER: Yes.

LONG: -- in collections. Not everything here is a collection.

GOLDHAMMER: Okay.

LONG: Right? And I think for me this is very constraining actually, to say okay, we're doing collections. But I, you know, we say this is a system problem, right, and there's an overall system architecture and we're trying to look at this one little piece, right? And I put something down and you pooh-poohed it so I tore it up and it's gone.

GOLDHAMMER: I wasn't pooh-poohing it. I was asking you actually to elaborate on it.

LONG: It doesn't fit in, it doesn't fit there. It doesn't fit in collections.

VELOSA: Put it somewhere else because look, I put some things on the side.

LONG: Yeah, I did, you know.

VELOSA: I don't see where you put it. Are these yours?

GRAY: No, these are mine. This is down in kind of the analysis, how do we actually do something with it? What are we doing?

[Simultaneous comments]

VELOSA: If it is very important. I would suggest you write it down, put it down, 'cause we need to address it at some point because architecture is fundamental.

GRAY: What I conceptually see is, like we talked about before. We talked about the active and passive. And so I think the passive process is probably our first ask, kind of hierarchically, where you have the passive process where --

LONG: Materials engineer. I understand. It's like lots of complicated processes, right?

VELOSA: -- you're gather information, you know. So this is passive so --

[Simultaneous conversation]

LONG: Unless you're just pushing atoms around or something.

VELOSA: And when I say passive, it would be active monitoring.

LONG: Yeah, yeah.

GRAY: All of these, like data mining and different things like that. So what you're trying to do is you're trying to identify the big question and then on the next part, which is the active part, I think that feeds the active part, which says, you know, you're trying to come out and say, you know, are we right, are we wrong, you know, and try to get the input from --

GOLDHAMMER: We're trying to elicit a response.

GRAY: Elicit the response and then this comes back up to here and at some point, you know, you have to then say okay I have that input. Now whether -- you know, and again, up here, this is passive and this is --

Transcripts were not edited.

VELOSA: Yeah, you have two types of sonar, right? This is the active pulse that's the--

GRAY: Yeah, so this is passive ID and this is for technology, applications, etc.

BLOUNT: I think that one thing is missing, a step ahead of that, which is you've got to generate a hypothesis before you start --

GRAY: Right, right, hypothesis generation.

[Simultaneous comments]

GOLDHAMMER: You're at the head of the class.

LONG: But you also need to have a team. I mean, to me that's the problem.

GOLDHAMMER: Yeah, so, Darrell, a part of what I was getting at is like what is actually happening there. Is it a team of people generating hypotheses?

LONG: It's as many as you can afford.

VELOSA: Where are you going to put -- because I want to put this one with yours.

LONG: And I don't think – this isn't necessarily linear.

GRAY: No, no, no, it's not linear.

BLOUNT: I actually think this is passiveness.

[Simultaneous comments]

LONG: So we've talked about this a couple of times, right?

GRAY: Yeah, yeah.

LONG: You have teams that are observing what's happening in the world, right?

GRAY: Arrows, arrows.

LONG: And we didn't do this before. I mean, we're being recorded but if -- look, if you look at the movies --

VELOSA: We're working on things that drive you nuts.

[Simultaneous conversation]

LONG: -- the movies that are being produced right now, right? Al Gore goes off, rant, rant, rant, he's Al Gore, and we get movies about the end of the world, you know, New York City being frozen after being flooded, right? In the 1950's we're scared of Sputnik. We get space alien movies, okay?

Transcripts were not edited.

So what you want is you want people observing the world, okay, the data's coming in, and that feeds back into the kind of hypotheses that they're creating. Hypotheses are generated. Other people that understand the technology or the social structure or whatever take those hypotheses along with data and say are these reasonable – what do we call them, Stewart? -- long bets to make. All right. You know, we start looking at climate things, for example, and we believe that this is going to cause starvation in Western China, which is going to cause migrations of people, which is going to cause social pressures, which is going to blah, blah, blah, blah.

GOLDHAMMER: Yeah. No, I think that's right. I think that's right. So there's a hypothesis engine that sits on top of this, which I think is right.

LONG: Well, it's not necessarily on top of it. These things are happening in parallel, right?

GOLDHAMMER: Yes.

LONG: And with feedback loops.

[Simultaneous comments]

VONOG: beause usually this is [..?..] and this is arrows. Like this is a point and we have both at the same time --

GOLDHAMMER: Arrows? We got arrows right there.

VONOG: Oh, arrows? [..?..]

LONG: So hypotheses inform data gathering, data gathering informs hypothesis formulization, okay? And then there's an evaluation step which says this is a reasonable hypothesis, I'd like more data on this, or this is complete nonsense. Go away. The Chinese are not building a time machine.

GOLDHAMMER: Right, at least that we know about.

[Simultaneous comments]

VONOG: residual trends. Can we put trends and see where they come out

LONG: And violence causes. They're not building a time machine.

CULPEPPER: So we've got the hypothesis engineer, you've got the passive and active listening, you've got --

GOLDHAMMER: Guys, can you help us kind of sort of put some organization to this?

GRAY: All right, so --

GOLDHAMMER: These things are all, this is a system, right?

Transcripts were not edited.

LONG: So by active do you mean it's okay if we tickle the system and see what happens?

GRAY: Yeah, that's what I'm saying.

LONG: Right? We go poke the monkey with ….into Iraq?

GOLDHAMMER: This is poking the system.

PAYNE: Darrell actually is going to raise his hand to volunteer. [Chuckles]

GOLDHAMMER: So take a look at some of these. Where do they fit? Do they fit in the passive or active part of the system?

CULPEPPER: I'd put media tracking, passive, culture media, passive. I'd put , passive.

VONOG: I think there should be like trend …., evaluation

GOLDHAMMER: U.S. foreign media movie tracking, passive.

GRAY: Passive.

PAYNE: I'm sorry. Stan said something. What'd you say?

VONOG: I said like maybe we should put like a trends, evaluation, like identification and evaluation. Like for example, when we're designing products we're thinking what trends are leading us–

[Simultaneous comments]

GOLDHAMMER: Enthusiast tracking, passive?

GOLDHAMMER: So that one's active.

GOLDHAMMER: Enthusiast tracking, passive?

CULPEPPER: Yeah, passive.

VONOG: And then you kind of build for the future, not for now, because it will be obsolete by the time you have this product ready.

GOLDHAMMER: Precursor tracking?

CULPEPPER: Still passive.

[Simultaneous comments]

GOLDHAMMER: Story generation is definitely active, right? Or there. Okay.

Transcripts were not edited.

CULPEPPER: Story generation, I like that. Competitions inside the military, prefer enlisted folks. Is that active? Or competitions?

[Simultaneous comments]

UNKNOWN: [..?..] [..?..] board, media. That's passive, I would say.

[Simultaneous conversation]

VONOG: Well, I mean we are designing our product right now so if we would be designing for like today's [..?..]

GOLDHAMMER: Irritators, that's definitely active, right?

VONOG: By the time we're done it will be obsolete.

PAYNE: Right. Right.

VONOG: So what we have to do is kind of hypothesize, see a trend [..?..]

GOLDHAMMER: Yep. I think -- Where did Harry go? Harry, are irritators active or passive, in terms of sort of gathering -- Well are you pinging the system or are you [..?..]?

[Simultaneous conversations…]

VONOG: It's when you have hypotheses then you look at trends and see if it's going to happen or when and how [..?..]

GRAY: So here are these to add in somewhere.

GOLDHAMMER: Team stewards system design, where do we put that? Maybe under hypothesis engine?

LONG: Who is red?

GOLDHAMMER: I don't know, it's –

[Simultaneous comments]

GOLDHAMMER: Team steward system design? You want that –

UNKNOWN: Yeah, that would be hypothesis engine, yeah. And the same thing for that.

GOLDHAMMER: Hypothesis evaluation. So these are precursors, application valuation, system architecture. Who did system architecture?

BLOUNT: Darrell, was this you, system architecture?

Transcripts were not edited.

LONG: Yeah, yeah, that's just a reminder that we have to come up with some sort of system architecture. Okay.

GOLDHAMMER: Collaboration tools, people networks. Who did this one, collaboration tools and people networks?

UNKNOWN: Who's orange?

GOLDHAMMER: Collaboration tools and people networks, who was that?

[Simultaneous comments]

VONOG: Trends is different from hypothesis, trends is like what's happening.

UNKNOWN: I thought we had that under --

UNKNOWN: Somewhere in there I think?

PAYNE: But no, he's saying that that continues throughout the process so that you don't – you reevaluate your hypothesis throughout the whole process. So that, you know, like say you're building this for today but as you move along, a year or two years from now, the trends may have changed, you know, what your hypothesis may have been.

GRAY: And that doesn't necessarily change, that doesn't change the system architecture. Yeah, it doesn't change the architecture. It's just a matter that the output, the output comes back in here.

PAYNE: Maybe this feeds into this.

GRAY: Well and the fact that this actually feeds back and that's the –

VONOG: I was just saying like a startup, the only thing we'd do [..?..] future forecasting is kind we are trying to build a product and we want to build it so that it's actual three years after. So we kind of think, "Oh, this trend is important for us so we think it's going to happen," and like out of five define three and really bet on them also.

BLOUNT: I think we're still missing a step at the top. Before you can actually generate big questions you have to understand who the customer is and what drives their world.

GRAY: Well, and that actually, it's kind of interesting 'cause that's going to be that big, that's going to be that big loop down here. 'Cause we need to start with who's the customer but then at the end the customer is also going to give us feedback to tune the system.

BLOUNT: Right. But for instance, if you're the stakeholder of a hospital versus -- So I think you have to set with kind of a definition of impact, you know, what rocks their world, positively and negatively.

Transcripts were not edited.

[Simultaneous comments]

VELOSA: So this is a double-loop learning cycle, right?

BLOUNT: Right, but how can you ask a question, right -- I mean --

VELOSA: You have to know who your audience is so it's just essentially go back to what's important to them but --

CULPEPPER: I think quick big picture questions I think is, there's a lot you can put there, right, you know, by sector. I would almost think of it as like, you know, my sector is bitter that different issues, you know.

[Report of Ft. Hood shooting, continuing side conversation about terrorist attacks.]

[General conversation]

GRAY: Well what, Darrell, what did you mean?

LONG: Identify the customer. Identify the stakeholder.

LONG: No, no, that's not what I meant. What I meant by this is there's another thing up here, identify the customer. But then there's going to be things inside the "in here" that inform -- you know, you're interested in energy, okay, so you define this whole thing energy, right?

GOLDHAMMER: In the context of energy, yeah.

LONG: But there's stuff that's going on that's going to affect energy, right? You know, there's social things, there's climate change, there's all this stuff, and this is going to inform what kind of hypotheses get generated, okay?

GOLDHAMMER: Yeah.

LONG: So, you know, if we're worried about drought suddenly and massive migrations of people, right, then we're going to generate different hypotheses than if we're worried about, you know, the Northern Hemisphere becoming frozen, okay? There's going to be different sets of hypotheses. So these are the big sort of large motivating questions, right, that sort of set the stage for things, right?

GOLDHAMMER: Uh-huh.

LONG: Like I said, 1950's movies, all about space aliens 'cause we're worried about Sputnik, okay? What are we really worried about, okay, on a large granularity and then what hypotheses can we make about what kind of technologies or uses are going to get popped out and we use the data to inform that and then it gets evaluated, whether this is nonsense or not, my favorite being the Chinese time machine.

[Simultaneous comments]

Transcripts were not edited.

GRAY: Here you go. Here you go, Al. Yeah, here you go though. But the thing is, it's expert versus every man.

VELOSA: Okay, yeah. Well actually every man and then another one for generalist 'cause you want, you don't want that distinction in there.

BLOUNT: But again, the customer could be, it could, these could be your customers.

[Simultaneous comments]

LONG: I'm not sure how these, certainly how these affect, right? These are people that generate these. These are generators of experts saying, "Oh, gosh, you know, we've got to worry about climate change" and, you know, everyman saying oh…

GOLDHAMMER: I've got a job, I need a job.

LONG: Yeah.

GOLDHAMMER: How come I don't have a job?

LONG: You took my job.

GOLDHAMMER: Yeah.

VELOSA: It's just like thank you for the rf. I need money now for my solar project.

GOLDHAMMER: You know, if we're worried about jobs, right, this leads to outsourcing and, you know, all these other things.

GRAY: Thanks for air-dropping the iPods in the Sahara Desert. Unfortunately, what do I do when the battery dies? [Laughter]

GOLDHAMMER: What's the connection between this sort of stakeholder audience, which is sort of -- that's the connection between that and this part?

VELOSA: Because they start the big picture questions.

GOLDHAMMER: They're asking the big picture questions.

GRAY: Right. So I think –

BLOUNT: So it's the big question to hospital is different than to a city, than to the globe.

VELOSA: Right.

GRAY: But I kind of got the impression that we wanted to, we wanted to try to vet the big question.

VELOSA: Oh, I see what you're saying.

GRAY: With, with these, within these levels of expertise. We wanted to vet the big questions, okay, or get buy-in. I mean, you know, because I think the first thing you have to do is, is there – what is the big question and if you're identifying the big question, what's the big question for whom?

VELOSA: And even iterate it.

BLOUNT: Well, but if you're going to vet it though, it's almost, you almost have to start with the hypothesis before you vet.

GRAY: That's true.

BLOUNT: So I think the question -- it feels to me like they belong up here or they belong --

GRAY: Okay.

LONG: Hold on, hold on, hold on.

LONG: So for me this means --

GRAY: Let me put them down here in the analysis.

BLOUNT: Well, yeah.

LONG: So for me this box says what am I worried about. What keeps me awake at night?

CULPEPPER: Or I want to conquer the world.

LONG: Or sure, yeah, world domination is always in favor [..?..]. [Laughter] So this keeps me awake at night either plotting or worrying, okay.

GRAY: And the stakeholder gives you guidance as to where you're going to be.

GOLDHAMMER: So this is really setting boundaries, it sounds like.

LONG: Right. So this is --

GOLDHAMMER: What we care about, what we don't care about.

LONG: Well, not so much boundaries as a basis of what we're thinking about.

CULPEPPER: It's a frame that you hang things on.

LONG: Yeah. So you know, Stewart's over there but climate would be a big thing here, right? And so everybody's worried about climate so that's going to cause the hypothesis generators to generate things that are related or could not necessarily cause this but are caused by it or impacted or whatever.

GRAY: EPA comes in and says this. NIEHS comes in and says this. DOD comes in and says this. But we still run it through the same process.

LONG: But it could --

VELOSA: Or Senator Acme says, "I need to get re-elected" or "My constituents need jobs --

[Simultaneous comments]

GRAY: My state says this.

LONG: Okay, but I think, and I think it can be broader than that, okay, not just the stakeholder says this, right? We've got to be smarter than them, right? They have a narrow view of what they want, right? We have, you know, during the Cold War what did we think about? Oh, the Russians, the Russians, the Russians, right? Couldn't think about anything else. We actually need to think about things though. Then the Chinese and the Russians at this point, you know, we need to think broader. So don't let them say –okay, this is the thing for following the Chinese, right?

CULPEPPER: I mean, that could be anybody, right? Like it could be a monopoly, it could be --

LONG: It could be a monopoly, it could be anything like that but what's the broad questions that you frame it? Here's the technologies that are popping up, right? You're seeing them passively, you're just kind of noticing, watching the literature, the money flows, whatever. Here, over here you're pinging the system, right? You poke the monkey in the cage and see how it reacts.

GOLDHAMMER: Uh-huh. And then it comes down to a -- so then these – we generate a bunch of hypotheses based on that information collection and then it gets evaluated down here.

LONG: Yeah. These are the science-fiction writers, these are the guys that have happy dreams and bad dreams, okay, and say that I'm worried about this happening. These are the people that can analytically look at things coldly and say, "The Chinese are not building a time machine, that violates causality. It's okay, you don't need to worry about that thing," okay? But the biologist, you know, monkeying around just manufacturing, maybe you need to worry about that one a little bit. Okay? That's these guys. And then there's a feedback loop, right, feedback loop coming back here and they're saying to the hypothesis guys, "Don't worry about that, okay? Time machine's not going to happen, right?" There's a feedback loop that says, "This is very, very interesting. What you said is an interesting hypothesis. I want more data," okay, and it feeds back here.

Transcripts were not edited.

GOLDHAMMER: Where is it? Show me that feedback loop again.

LONG: This loop goes back here and here and here.

VELOSA: But it goes all the way back here 'cause, you know, every so often you've got to check the stakeholders and make sure this is still relevant.

LONG: Yeah, yeah.

BRAND: So are the evaluated hypotheses the product?

LONG: They could be.

CULPEPPER: I kind of think it is.

LONG: Maybe there's a little bit more happening here.

CUKPEPPER: Yeah, maybe there's something on the tail end there.

BRAND: What is that? What comes out of this is what these people want, presumably, or is it something else? Or is there a context builder down here?

LONG: Yeah, I think there's a context builder. There's somebody that's like this down here saying, "That's very nice but we don't really care about that," or "Oh, my gosh, that's a big deal."

GOLDHAMMER: So what prioritization --

LONG: There's a policy, there's a policy kind of -- this is a technical evaluation, okay? There's a policy evaluation down here.

GOLDHAMMER: Let's capture that.

GOLDHAMMER: Is everyone in agreement with that, by the way?

[Simultaneous comments]

PAYNE: The output is investments?

VELOSA: What is the output? At the end of all this work?

GOLDHAMMER: Darrell, would you say that again just to put a stake in the ground?

LONG: So I'm saying this is more of a technical evaluation. Here there needs to be a policy evaluation step, okay?

GRAY: Policy…?

LONG: Policy, you know, decision-maker, you know, humanities major, lawyer kind of evaluation, right, those guys that actually control the money and don't like the decimal places, okay? Is this going to affect the policy decisions?

BRAND: So these are the storytellers that go ahead and talk to these guys?

GRAY: I don't, I don't see that as linear. I see that as – I see this hypothesis evaluation as being multiple sources of evaluation.

[Simultaneous comments]

GRAY: So you have a technology evaluation, you have a political evaluation, you have, you know --

PAYNE: I would think you should.

LONG: In my experience, these people are not particularly imaginative.

PAYNE: That's true.

LONG: So for me – you guys can overrule me – these are the guys that are imaginative, okay? They're coming up with, these guys are the guys that have nightmares and happy dreams that think of "Oh, my gosh, what could happen?" And I don't want to constrain them. I want them to say, "What could I possibly do with all these wonderful technologies that are popping out?" Okay? If I put these policymakers and stakeholders in here then they mess things up

[Simultaneous comments]

PAYNE: That's why I thought they were down here because they've got to put –

LONG: No. These guys don't know anything about decimal places, okay?

PAYNE: Well I know but they do know about how -- one thing they know is –

LONG: Put them down here, okay?

PAYNE: Okay.

LONG: I want to put them down here because I've seen this many times where you take and you go and you scare the humanity majors, okay, and they go, "Oh, my gosh, could that happen?" And it's complete technical nonsense! okay?

GOLDHAMMER: So you've got a bunch of different -- this is an evaluative?

GRAY: Right. So this is the eval- and I don't like -- I mean, again, I go back to it's not technical. Hypothesis evaluation is all of these things, scitech, gaming and crowd sourcing, social --

Transcripts were not edited.

LONG: So these things are really glued down to the bottom of this, okay?

GRAY: Okay.

LONG: Okay, so technical’s the wrong word.

VELOSA: Because then this has to have outputs that are then, you know, policies, priorities, whatever else.

GRAY: Right, right. And that’s what I kind of threw down here, is these people, at this level we need to come up with a scoring system.

LONG: So these are clever expert type people.

GRAY: Yeah, yeah.

LONG: Okay? So this is expert evaluation, all right?

GRAY: And this brings in the non-experts so this brings in -- the generalists, the everyman is coming in in this piece. And then we have some sort of scoring system. I mean, when you throw a set of assumptions into a gaming system there are going to be a group of people that say, “The game’s wrong because this and this and this are screwed up” and they’re going to throw it out and dismiss it and maybe that’s what we need to take away from it is, we need to throw those out and dismiss it and go back.

LONG: So you’re saying, for example, this financial person can say, “That’s never going to happen because this is going to cost a billion dollars,” right?

GRAY: It’s going to cost a billion dollars or for that, like the guy on his own in Montana who has no connections to anything to bring his technology to light, it’s not going to happen.

LONG: Yeah. He publishes it and then --

GRAY: But somebody else does, that’s a different story.

LONG: Yeah. Right. I’m a little worried about the everyman 'cause to me that seems it’s adoption issues, right? We’re not making iPods here.

VELOSA: No, I get that but, you know, there’s a certain group think that elites have and I’m including us in the elites just 'cause we’re way overeducated.

LONG: Yeah.

VELOSA: Right? this room is just way overeducated –

LONG: Yeah. I'm happy to have these guys here but I'm just wondering exactly what their role is.

GRAY: Well I mean, it needs to be -- ultimately what comes out of cloud sourcing and gaming is going to have to be evaluated and fed back into the system with some sort of rank score.

LONG: Right.

GOLDHAMMER: Right? So –

LONG: 'Cause, you know, these guys --

PAYNE: And they have to be in here or then again you'll have bias in here too, if you don't have these folks in there somewhere in the process.

GRAY: Right. So this I see as coming out and these are the people that help to remove some of the bias that's inherent up to here.

PAYNE: Right.

LONG: Right. But some people need – you know, I'm a technical guy, sorry, right, and --

VELOSA: Right, but that's the point of going to the favela. I mean, would you have thought of trying to shoot down that helicopter? I mean –

LONG: Well yeah, actually, but --

GRAY: Yeah, but that's beside the point.

LONG: But that's beside the point. That -- by the way, for me, okay, these everymen and everything, they're back up here in hypothesis generation, okay? They're coming up with clever ideas. They're not telling me whether it will work or not.

PAYNE: Well. Sometimes it will because if there's no political or social economic will to do something then that may lower it on the priority. It may not eliminate it because it's still a possibility but it may lower on the priority on where you put your bets.

VELOSA: But I think Darrell's point is very valid. In fact we should have them here and there.

PAYNE: Right, exactly. Right, they shouldn't come in. They should be involved somewhere in. They have to be involved.

[Simultaneous comments]

LONG: Let's do my Chinese time machine. Oh, crap, these guys are dreamers.

Transcripts were not edited.

VELOSA: You know, you keep raising it and then you keep telling us it's impossible.

[Laughter]

LONG: No, I just took physics. Okay, look, so but these guys are dreamers, okay? They make up some, "Oh, my gosh, we see all of these things" – maybe the Chinese time machine, right, and these guys are going to come down here and the gamers are going to say, "Oh, yeah, time machines. Those are cool." Okay, and they're going to want to do this and these guys are going to -- the only people who are going to say no to the time machine are here.

VELOSA: Well, Neil Stephenson proved that it worked.

Ehhhh.

BRAND: Two more questions.

GOLDHAMMER: We'll talk about Neil Stephenson later.

[Simultaneous comments]

GOLDHAMMER: Two more questions, here we go.

BRAND: Two more questions.

LONG: So I think these guys are here, right, but then there's – some judgment has to happen. But these guys are also here, you know, saying, "Well we've got all this cool stuff. What cool stuff can we do?"

GOLDHAMMER: Okay. Questions, Stewart?

BRAND: Two more questions.

[Simultaneous comments]

GOLDHAMMER: Hold on, Guys.

BRAND: Okay, there's two categories that don't exist here yet. One is the output. Maybe that's where they were talking about. What is the output of this which is going to make the stakeholder audiences happy, and are we going to play the persistence gig, which is our specialty?

SAFFO: In the spirit of that, I have an output for you.

VELOSA: Oh, okay, that would be a better place for that.

SAFFO: Pitch movie proposal to Dreamworks.

GRAY: [Laughter] I love that.

Transcripts were not edited.

BLOUNT: [Chuckles] Nice, nice.

BRAND: That's fair and then actually make the trailer and show it to the audiences.

BLOUNT: I love that idea. Seriously, I love that idea.

GOLDHAMMER: What is – other than the movie proposal to Dreamworks, what other outputs are there? There might be multiple outputs.

VELOSA: I think there's new questions.

GOLDHAMMER: New questions as part of the feedback.

[Simultaneous comments]

BRAND: The thing is, there's some entity that decides what the outputs are and this is the judgment.

CULPEPPER: I think one of the outputs is a long bet.

PAYNE: Right, is the forecast.

BRAND: That's fair. I like that.

CULPEPPER: The long bet, the collective entity that says, "This is the long bet".

UNKNOWN: Long bets.

SAFFO: And for those of you who haven't seen long bets, the longest bet on the site is a bet between Danny Hillus and Nathan Miravel over whether the universe will stop expanding or not. And Nathan claims that he's already won the bet and Danny just doesn't understand the question.

BRAND: Nathan is ahead right now but that could change.

BLOUNT: But in all seriousness, to Paul's note on Dreamworks is, you know, one piece of feedback you could create is to create a movie short, put it out on the Net, or create a two-day game ala, you know, some of the simulations that are out there and get people to live it.

PAYNE: Yep.

BRAND: Actually everybody can make their own videos now. Whoever lives down here in this part of the company just make a video and that's what you send over to these guys, probably not to the world 'cause some of them will be quite threatening and –

[Simultaneous comments]

Transcripts were not edited.

BLOUNT: Right, but if I think of the Army -- what's the Army game that was created online?

[Simultaneous comments]

LONG: America's Army.

BLOUNT: America's Army, yeah.

BRAND: That's another thing you can do, a game.

LONG: Much beloved by the Germans.

BLOUNT: You could create a lot of different scenarios within a framework.

BRAND: So how does persistence play in all this? Just do it again and again or what?

PAYNE: That goes with the new questions.

LONG: This is coming in all the time, the unblinking eye.

VELOSA: The eye in the sky, right?

LONG: Unblinking eye.

VELOSA: Oh, so that's your "always data coming in?"

BRAND: Always data coming in.

[Simultaneous comments]

VELOSA: Right. So there's data coming in, what are you doing with your hypothesis over time.

LONG: These are hypothesis generators.

BRAND: Are they looking at the output as well as [..?..]

VELOSA: Well, you do get new questions. But you do get new questions.

LONG: Exactly. We need at some point to get a loop all the way back up to [..?..] at some point, somewhere.

GOLDHAMMER: There you go.

GRAY: So I talked to, I was talking to Harry earlier and that is one of the, one of the – it was, Techcast, was the idea of coming in –

[Simultaneous comments]

Transcripts were not edited.

BRAND: That’s the reporting to them. We want feedback that goes through these guys and all of that output there [..?..] constantly looking at.

VELOSA: Well then go both to stakeholders and then to --

LONG: It needs to go both, not through.

VELOSA: Oh, I see what you’re saying.

GRAY: Okay, so it has to fork.

LONG: If it goes through these guys, and no offense to the policymakers, but they’re not the most imaginative people in the world.

[Simultaneous comments]

VELOSA: Actually, give me two arrows.

GOLDHAMMER: Oh, give you two arrows too.

VELOSA: Yeah, just give me two 'cause then we’ll point. This is a fork. It’s not .

GOLDHAMMER: Arrows are right here.

CULPEPPER: So to the question on what the output is, shouldn't we also have some sort of like -- Out of this whole process, what was our odds on after year one, year two, year three, year five, year ten, right? Basically what you do with long bets but formalizing that and say you know what we’d really like to do is we’d like to be on mark, you know, out of this engine 80% of the time or 70% of the time or whatever the number is, right? ‘Cause right now there is no odds on. I mean, that’s kind of my takeaway from all this. The whole reason this exercise is occurring is 'cause people are not happy with the outputs they’re getting right now, right, or they’re not getting outputs at all, you know, or they’re so wildly off the mark that they need better

[Simultaneous comments]

BRAND: So what’s the nature of the effective forethought

GOLDHAMMER: Well that’s -- So here’s –

BRAND: Good policy, right?

GRAY: This goes back to --

LONG: Yeah, yes.

BRAND: Leading the world peace. I have it down there [..?..].

UNKNOWN: Yeah, yeah, all right.

Transcripts were not edited.

GRAY This goes back to something I was trying to get back to and that is something quantifiable and that is where I brought up Techcast, was what -- The presentation we got for Techcast was you get all these things, you have the experts rank it and then what they delivered was consensus of the experts. I don't like that. One, I don't want to trust everything to the expert, which we've built into the system we're not going to do. Two, I don't like throwing out the outliers. But if we generate a ranking analysis and we report both the consensus and the outliers with the scores, then we can go back in each iteration and say how successful was the consensus in prediction and how was the outlier in prediction.

CULPEPPER: Right, right.

BRAND: Hovering right about here, the brilliant fucking leader, and hovering right about here the great storyteller who's often a different person.

[Simultaneous comments]

GOLDHAMMER: I actually think there is a narrative engine or some narrative component to this down here. I think someone has to generate that stuff.

GRAY: I think that's, I think that's here. I think that's where the narrative comes from is that now you have all of these, you have all of this as outputs but you need somebody who's going to take this and this is where that loop then comes back.

GOLDHAMMER: So this loop here?

GRAY: Yeah, so the narrative --

LONG: Be really careful with that loop, okay? Because we forked back here. I think --

GRAY: Okay, so maybe the narrative –

LONG: These guys get different than these guys.

GRAY: Yes, the hypothesis engine, these guys get the raw outputs –

LONG: Yes, this goes here.

GOLDHAMMER: These are raw outputs?

LONG: Yeah.

GOLDHAMMER: So this is the output so this goes –

[Simultaneous comments]

Transcripts were not edited.

VELOSA: So wait. Do you want me to write “raw” for the hypothesis?

GRAY: Well you can say “raw”, yeah.

BRAND: Yeah, you’re right. Raw goes to the hypothesis and story goes --

LONG: Right, and then, and the narrative output goes to the stakeholder.

GOLDHAMMER: All right. So this goes up to stakeholder?

GRAY: Yeah, this goes up to stakeholder, yeah.

LONG: So this, this is – this is after the decimal places are removed.

GOLDHAMMER: Yes, yes, thank you.

BRAND: And if it all works, then we get the product.

GOLDHAMMER: Yeah.

CULPEPPER: Or should we just write “the increasing DOD budget” on there?

BRAND: No, wrong.

CULPEPPER: I guess that’s on the record too.

LONG: This is where you put pictures of polar bears.

GOLDHAMMER: That’s right.

LONG: The lonely polar bear sitting there, right? This is – the real data goes back here and the lonely polar bear picture goes here.

BRAND: No, the happy large liver.

GOLDHAMMER: I’m going to kind of, I’m going to convene this meeting back together and I think what we’re going to have to do is it’s going to be like a little bit of a movable feast. I think we’re going to just go from table to table to table and see what other people have done.

LONG: Okay. Let’s see. There’s one more thing here. Where’d Harry go?

BLOUNT: I’m here. I’m hiding.

LONG: Okay, so I think Harry, you or Danny were saying this, right, about what comes out here in the measureableness of this and what I don’t want to do is say these guys were wrong, I’m throwing it out. They might just have been wrong on the timing.

BLOUNT: Yeah.

Transcripts were not edited.

LONG: Right? You know, you might predict flying cars by 1970, okay? It didn't happen.

BLOUNT: And we got ripped off on that one.

UNKNOWN: We got what we'll never have flying cars.

BLOUNT: I mean, the real life example is the Twin Towers were built to withstand an airplane. We didn't continue to ask the question from 1960 in the design principle to monitor certain conditions.

LONG: Right. So, you know, a prediction, for lack of a better word, or forecasting come through this, okay, and the idea's right. It's just the timing's wrong. So if we say "I predict, you know, by 1970, you know, something", right, we're not Criswell, right?

BLOUNT: Well, but if you frame your narrative right, here's the thesis, here's kind of what has to happen in the story line and through what has to happen in the story line you get your enablers and inhibitors out of it that then create the tracking tools to go up in there.

LONG: Right, right. So this guy talking to the senators and the Congress critters doesn't need to bring everything forward, okay?

BLOUNT: No, no. But I –

LONG: It needs to bring forward the compelling things.

BLOUNT: But the narrative engine has to, what has to be the key elements of the narrative has to be, you know, what has to happen –

LONG: Yeah, right.

GRAY: It has to have a recommendation of how to use the information.

LONG: Right? I mean, what I don't want is something to come here that it's possible but low probability and this guy spits out a boogeyman.

GRAY: Right.

PAYNE: But – and it depends. If it's low probability, it has to have high impact if it's going to be important to us.

CULPEPPER: Right. Yeah. But –

LONG: But you know, it's more than just impact, right? There's a cost associated with things, right? I mean, I fly a lot and it annoys the hell out of me that I have to take off my shoes and do all of this other stuff. I fly in Europe, I don't have to take off my shoes, you know. And realistically a lot of this is theater because somebody goes, "Oh, my gosh, if another airplane crashes into something it's the end of the world." It's not, you know. Just

Transcripts were not edited.

people need to be able to do the arithmetic on this. So I don't want the bogeyman to pop

[Simultaneous comments]

LONG: You know, the most important thing that ever happened for airline safety is they made the door to the cockpit secure. Everything else is theater.

PAYNE: Which, oh, by the way, they were told to do years ago but they didn't want to do it because it was going to cost $10 more per plane or something.

LONG: Yeah. The rest of this is theater.

GRAY: This really needs to include a cost/benefit analysis.

BLOUNT: Which is what you do with your portfolio.

GRAY: Yeah, but I think it definitely is a cost/benefit analysis. This is a weak signal but I'm [..?..]

PAYNE: Yeah, you’re right, you’re right. But hopefully, if you’ve done this process right, by the time you get down here you have something that’s beyond theater. It’s actual probability.

[Simultaneous conversations]

GRAY: See, we brought this up. [Chuckles]

BLOUNT: We got it, man.

GRAY: We’ve got to have it in there.

BLOUNT: Yeah.

GRAY: Because that’s the, that’s, this is -- I think within this what we’re able to do is we’re able to take racial, socioeconomic, you know, educational bias out in this step.

BLOUNT: That’s why the openness part is so critical.

GRAY: We still haven't addressed how we’re going to make it beneficial for some of these players --

GOLDHAMMER: All right, we’re going to do the first -- actually, Darrell, would you mind, could you walk people through what we’ve done?

LONG: As long as I get a little help from a couple other people, right?

GOLDHAMMER: Absolutely. That’d be great.

Transcripts were not edited.

BRAND: What kind of things -- our deal was persistence, which means feedback, and what part of the output should go back into the hypothesis engine which drives the whole thing, part through the narrative that goes back to the audience.

SCHWARTZ: I've looked at all three. Everybody took a different approach. That's perfect, exactly what we were looking to happen. So when we meet tomorrow in the committee we actually have some very good options.

Feedback to workshop participants in Appendix D.

Team Activity: Identifying the Human and Technical Requirements

GOLDHAMMER: All right, where's our team?

PAYNE: They quit. [Chuckles] They're resting on their laurels.

GOLDHAMMER: Oh, they are. Look at that.

GRAY: They're contract holdouts. They'll be here eventually.

GOLDHAMMER: Yeah, they're waiting for their bonus. All right so –

PAYNE: Move the coffee and doughnuts over this way.

[Side comments continue]

GOLDHAMMER: So I guess two choices. The first question is there energy within the group to try to revise anything that we've done on the back end? There was a suggestion from, I think it was Stewart, actually, he made --

BLOUNT: He made it but I don't think we need to do that. That can be done by the committee tomorrow.

GOLDHAMMER: I don't know whether we need to do that. Is there any energy to sort of, to flesh this out a little bit back here, like what the actual outputs are, the reports or something like that?

SAFFO: I think Stewart's suggestion is great but I think it's done --

BRAND: Grab their four things, plop them on there, we're done.

GRAY: Yeah, I mean, there you go.

SAFFO: This could be done digital.

VONOG Maybe also run a well known thing like conventional cell phone release to see like hypothetically if it could sort of come through this process or something like that.

Transcripts were not edited.

GOLDHAMMER: Okay.

GRAY: So you're saying come up with –

VONOG: A story which is well known like, I don't know, Google, Apple, cell phone, whatever.

GRAY: Yeah. So maybe take three sample inputs. Take a technology input, take an application input and take maybe a, you know, a market combination of what –

VONOG: Yeah, but someone has to know the story, what was like the environment before that.

GRAY: Right, right.

PAYNE: A business case where you strip all the names.

GRAY: Yeah, and feed it through and then see how well it comes, well how well it scores through our system.

PAYNE: Right.

GOLDHAMMER: Let's do that and let's do, actually let's multitask. I know they say anyone over 30 can't do that. Let's multitask. Let's actually run a technology through it, but then I'd love to also get a sense of who's doing what, whether there's – let's see if we can figure out what are the technologies, what are the people, what are the partnerships, what actually has to happen. And I'll try to record some of that as we walk through it, okay?

GRAY: Okay.

GOLDHAMMER: You want to pick -- The one thing that, you know, I don't know if, Ken, this would be helpful for you, but I was wondering if we should walk IED, like let's pretend it's, you know, 2000 or something like that, pre-IED world. I mean, that has to be the most disruptive technology –

VONOG: And maybe you tell like a little bit of the story–

[Simultaneous comments]

LONG: It's also technology from, you know, for fighting in the 1970's when people were slogging around Vietnam and we didn't solve it then either.

PAYNE: I don't know if IED's a good test case.

LONG: That wasn't a surprise.

GOLDHAMMER: Why don't you pick one then, pick a test case.

LONG:	But I think it’s important. IEDs were not a surprise. They weren't.
PAYNE:	Not even close to a surprise.
PAYNE:	And see the reason, and one of the reasons they were disruptive too is that Humvees were built to be supportive vehicles, not in the midst of war. So it wasn’t like, "Hey, you didn't build what you needed." It’s, you know, everything else changed too.
GOLDHAMMER:	That was the soft side, yeah.
PAYNE:	Right, and it took advantage of that.
LONG:	We came to fight a different war -- than we ended up fighting.
PAYNE:	Right. I’m trying to think of something [..?..].
LONG:	Okay, so here’s one for you. I’m doing timekeeping down to the "Oh, I don't know," second level, okay? And people, you know, your observers see that I’m doing that kind of [mike noise], okay? [mike noise]
PAYNE:	That’s….
LONG:	Okay? And then somebody observes that we can launch satellites, okay? Isn’t that clever, okay? And other people realize that there’s digital communication with, you know, coding and so forth.
VONOG:	That’s hypothetical. I was thinking more like you know the story and you’re not going to see when –

[Simultaneous comments]

LONG:	I know the story. Oh, you don’t recognize the story yet.
VONOG:	Okay, okay.
PAYNE:	You will.
LONG:	Okay? And this guy just read the book *Longitude*, okay?
VONOG:	Uh-huh. And when did it happen, like fento second? Did it happen before –
LONG:	And maybe it’s not fento second. Maybe even off by a couple orders of magnitude, it doesn't matter. I’d have to look at what the seasoned clocks are right now.
VONOG:	And so like the high level story behind the was that they invented this tiny fento second, whatever.

Transcripts were not edited.

LONG: Right, so atomic clocks, okay, atomic clocks are the result of 30 years of research and timekeeping.

VONOG: And when was that? Like can you tell who –

LONG: Starting in – gosh, help me out here – sixties, fifties? Fifties or sixties. It's a long-term story, until we got to the point where you could put these things on a satellite.

VONOG: Uh-huh. So they were small enough or…?

LONG: They're small enough now that they can go on –

VONOG: What were the metrics or something with this?

LONG: Well they used to be, they used to fill this room.

VONOG: I see.

LONG: Now they can put them on a satellite. Actually now you can buy them and you can put them in your routers, okay? And DARPA has them now that goes on a chip, Butnet.

VONOG: Yeah, in watches, they have, the Citizens, Citizen –

LONG: No, no, no, no. Those aren't, those are not atomic clocks. Those are just things that get the signals from atomic clocks. Okay, so we have atomic clocks that are now miniaturized. We have space launch and somebody read the book *Longitude*, right, which actually is later, after these things really came out. But -- you understand the *Longitude* story?

VONOG: And what's the longitude…?

LONG *Longitude* story is if you want to know your position on the Earth, and the British had a competition for this, to go north to south you look at the stars. East to west, you're screwed, okay? So what you would do? So what you would do is you would see where I -- I'm in jolly old England right now and --

SAFFO Screwed, you're just screwed if you're on a boat.

LONG: Well I think you're screwed if --

SAFFO: You can use lunar distances if you're on land [..?..]

LONG: Yeah, as long as you just keep track of where you are the whole time.

SAFFO: No, lunar distances from –

LONG: What can you do?

Transcripts were not edited.

SAFFO: -- as long as you have a table.

LONG: As long as you have a table. But you have to know how far you --

SAFFO: You’d have to be on land.

LONG: And you’d have to know how far you went.

SAFFO: You can use a stable platform.

LONG: Yeah. You have to know how far you went, right? So the story is that there was a competition and the British government were giving out a thousand pounds or something if somebody could keep time accurate to, you know, a second per week or something.

VONOG: So we would detect those kind of competitions through the system?

LONG: Right. So you detect competitions like this. So that’s the story but that’s a long time ago. And what happened was this guy developed a clock and he would say what time is it in England and I’m in England, okay, fine. And you get in your boat and you go and you say, "Well it’s noon now and in England it’s 4:00 p.m. so I must be here," okay? So time helps you determine position, okay? So these guys dream up things, satellites and clocks and things like that and you get GPS popping out at the end ultimately.

PAYNE: So what were the active processes claimed?

LONG: I don't know if it – I don't know. Maybe --

PAYNE: Engaged in academia?

LONG: I mean, this is something, I’m actually not that clear on what active is. I think perturbing the system.

GRAY: Yeah. This is where we were determining -- So actually the active system here is historically the competition -- The competition that someone read about historically was there but it was an active competition years ago. There’s no reason you couldn't do it now.

LONG: Yeah, and you could actually start a competition if you wanted to see what you wanted to, you know, you wanted --

SAFFO: Well you can summarize active competition with Arthur Clark’s famous quote, “The best way to predict the future is to invent it.” That’s the most extreme case.

GRAY: There you go.

LONG: All right, and these guys, they get this and they say well that’ll work or that won’t work or whatever and it comes out here.

Transcripts were not edited.

GOLDHAMMER: So the hypothesis, but just to be clear, so the hypothesis engine is actually saying well if you actually – if we saw someone playing around with, you know, highly accurate time, the ability to tell time, that could mean this, it could mean this, you could do it this way, you could do it that way.

LONG: It could mean this, right?

VONOG: Or maybe there is a big question first of time and then these guys [..?..] –

[Simultaneous comments]

GRAY: The hypothesis engine of the time would be I read this book about this competition. I know that there's this technology now that's a very, very accurate clock. The question is –

LONG: What could I do with it?

GRAY: -- with today's technology could I go back and do what they were trying to do 300 years ago, and if so –

LONG: Actually end up doing it completely differently.

GRAY: Doing it differently but could I do it? And the question is how would I do it and that comes down to here where you say okay, I have this hypothesis and it comes down to here and it's evaluating the technology and the hypothesis together and saying will it fly.

VONOG: And what happens next?

LONG: I didn't make these triangles.

PAYNE: Well but part of this is that where the –

LONG: Technically these guys will evaluate is this going to work technically, right?

VONOG: Oh, so these guys work here –

LONG: And these guys are in here.

GRAY: Yeah, yeah, these guys are part of this.

LONG: These guys say, "Oh, is there a business case for this?" The answer of course is no but the government pays for it anyway, right? And then we find out later that it's a multibillion dollar industry, but…

GRAY: Well and then, you know, social, political sci-fi.

LONG: These guys don't have to agree.

Transcripts were not edited.

BLOUNT: I think one of the questions I have here is how much of this structure here in terms of the filters is internal versus external.

GRAY: That's a good question.

BLOUNT: Because if it's all internal you're going to have, ultimately you're going to have a structural bias of some shape or form and –

LONG: I think it depends, right? Some of these things can be internal, some of -- okay. Let me just speak about this one, okay? The federal government right now, the state of affairs and their ability to do science and technology evaluation is abysmal. You know, all the -- there's no –

VONOG: It's bad or good?

[chuckles]

LONG: It's bad. There's no path to stars or flag rank for an engineering PhD in the military. There used to be. There's not anymore. Intelligence Agency have gutted this stuff so there's a –

BLOUNT: Complete inverse of China then.

BLOUNT: Complete inverse of China.

LONG: Complete inverse of China and frankly, it needs to get changed but we're run by lawyers so who knows. So this is going to have to have some other inputs like the national labs or places where you have contract scientists and things like that doing this. But you can have -- so I think the government needs to improve their science and technology internally and they're going to look at stuff and they're going to see things and they're going to say, "Huh, we don't really quite understand this. Let's go out and get some real external people to look at this." And I think that's reasonable and healthy. And probably financial is the same way, right? They really don't have any great financial people, otherwise they'd be on Wall Street making big money.

PAYNE: That's not necessarily true. I think like these, on an S&T and the gaming and cloud sourcing, are both and inside and outside the government.

GRAY: I think so too.

LONG: Yeah, inside and outside, yes.

PAYNE: But these, you don't -- the financial part –

[Simultaneous comments]

GOLDHAMMER: So is this Treasury and VCs or something like that?

Transcripts were not edited.

GRAY: Oh, hold on. Let me -- Let’s do this, let’s do this.

PAYNE: That’s probably not Treasury. ‘Cause every organization has their financial folks to help make those decisions.

GRAY: Let’s put this over here.

LONG: Yeah, good. Yes.

PAYNE: And so -- I don't know how well we do that but we’ve got those folks.

SAFFO: Post-docs.

LONG: There you go. The disgruntled post-docs.

GOLDHAMMER: Who are these people? Just put –

PAYNE: They’re within each organization. Everybody’s got their financial folks that tell you whether or not you can do it or really what they tell you is here’s your tradeoff. If you want to do this, you can’t do this.

LONG: So I don’t mean that kind of financial, right? I mean, here I mean like the VC kind of financial. Does this – is there a business case or financial pressure that would cause this to happen?

GRAY: Cause it to happen or cause it –

LONG: Or cause it not to happen.

GRAY: Not to happen.

PAYNE: But there’s some things, you know, you work -- Look at these two ways. One, if you’re concerned more that somebody else is doing this before you are, then your concern – then you say, "Hey, can this be done and what it's going to cost?" The other thing is can we do it first. You know, hey, there’s these two things together. Can we put this together and develop this system before somebody else?

GRAY: But what the venture capitalists are going to help decide here is --

LONG: This is a "can," this is a "will."

GRAY: -- is this a privately funded venture or is this a government funded venture? Something might come through and the VC guys are saying –

PAYNE: Right. That’s assuming somebody else is doing it before us.

GRAY: -- I can’t touch it. Right, right. I can’t touch it.

PAYNE: That’s assuming somebody else is doing it. If we’re ahead of the problem or we think we’re ahead of the problem, we’re looking at can we do it and how do we do it and finance [..?..].

GRAY: Well and that’s the question. And the VC guys are going to look at it and say, "Is this something that the private sector’s going to want to bid on, yes or no?" Even if we want to do it first, is the private sector going to want to bid on this or is this something that’s only going to fly if the government is there?

LONG: So Harry, would you have put financial backing on GPS twenty years ago?

BLOUNT: I have no idea, really have no idea.

LONG: Probably – I would hazard they would not.

PAYNE: Yeah, because the timeline on getting your return on investment is too long.

SAFFO: Well but this is just a matter of granularity, it’s the scale problem when you’re deciding to invest.

LONG: No, well this is a question of who’s going to do it, right?

PAYNE: And the other thing too is that, you know –

LONG: The government had a compelling need for this, right? It wanted the guys in the Army to know where the hell they are, okay? They didn't care about people driving around in their cars or me and my iPhone navigating the streets.

PAYNE: That’s when Harry’s folks come in.

LONG: That’s when they come in.

VELOSA: No, no. But the semiconductor firms and some of the electronics firms were in there because one, they had products that were relevant and they had contracts.

LONG: What is this?

VELOSA: The semiconductor and electronic firms.

LONG: In 1980’s?

VELOSA: They were starting to work on some of the parts for it. They didn't know GPS but they had some of the parts for it.

BLOUNT: I think we’re asking the wrong question.

Transcripts were not edited.

LONG: I don't know which part you're talking about.

SAFFO: I wouldn't push too hard on the GPS example. It's a nice one at a general level but it's not –

BLOUNT: I think you're getting to the question of asking the right question at the wrong time. So if we're designing this correctly, is GPS going to be feasible, is a disruptive? The financial guys may say, "Right now it's not feasible but here are the signposts for feasibility." That in and of itself becomes a persistent question that continues to echo through and then when you hit, boom, a price point, the semiconductor guys start making investments, what have you. So I think these guys are here to say --

GOLDHAMMER: So who are these guys? Who's doing that?

BLOUNT: I think in the social/political realm is if it is something like the National Highway System, you know, if one of the enablers is the National Highway System, that has to take some kind of political decision so that becomes an enabler in terms of length. That's a big enough project.

PAYNE: And like I said, those folks are kind of fairly senior folks but then whatever organization's asking the question, you know, it wasn't -- In that case it was like Department of Defense was asking that question so then you'd have some of the folks probably in DDR&E that were involved in that and just OSD, Office of Secretary of Defense.

VELOSA: But you've also got, you know, X congressman with his pet company and his territory is going and saying why are you buying?

PAYNE: Yeah, but we can't put them in the process.

VELOSA: But they are in the process though.

PAYNE: They're wildcards though, they're wildcards, 'cause you don't know. There's no logic behind –

UNKNOWN: They're external. Yeah.

[simultaneous comments]

LONG: You wouldn't go and get X congressman and put him in your system, right? They're external actors.

VELOSA: They're already in the system.

LONG: Not in this system if we're building a system.

[Simultaneous comments]

GOLDHAMMER: Yes, yes.

Transcripts were not edited.

BLOUNT: China’s going to need to consume massive quantities of resources over the next 20 years to support their economy. What are the key things as they go out and try to secure those resources to support their country long term, what are the social and political considerations that are going to enable the forks in the path?

GOLDHAMMER: But who’s doing -- A question I’m asking, which is who’s doing that evaluation? Is that just inside the government or are these academics doing it?

[Simultaneous comments]

LONG: No.

VONOG: Maybe it's like intelligence

LONG: I think you need to reach out, you need to be able to reach out to like external academics as well, right?

GOLDHAMMER: Uh-huh. Yep.

LONG: So for – whatever the experts are.

PAYNE: National Academies.

LONG: Sometimes but, you know, you need to be able to -- look, if you’re in the government and you see something going on and you have a concern, you need to be able to reach to somebody. National Academies has a long cycle time, okay? You should have your Rolodex, call up your favorite professor of, you know, minerals politics at a university and say, “Western Australia is being sold to the Chinese. What’s the impact here?” I mean, literally, that’s the – Australian economic boom is the fact they’re digging up all of Western Australia and shipping it to China.

GOLDHAMMER: Gaming and -- I’m just going to keep you guys focused here. Gaming and cloud sourcing. In this product, who’s doing this?

PAYNE: That’s internal and external because as far as Department of Defense is concerned, we do our own game in a lot of things, but we also use external organizations to do that as well.

GOLDHAMMER: Contractors, yeah.

GOLDHAMMER: So contractors?

GRAY: So you can use, yeah, so DOD, you’ve got contractors.

GOLDHAMMER: Okay? So this whole thing, I mean, the principle here is you actually have people inside and outside, across all the evaluation who are doing it. Is there any entity that is sort of managing this process that’s, you know, sort of figuring out what questions go to what people, what answers are good, what answers are bad?

VELOSA: I think it would be the team that – there has to be a team.

GOLDHAMMER: Okay.

GRAY: There has to be some sort of standing group that -- Because --

GOLDHAMMER: It’s an evaluation group.

GRAY: Yeah, that’s an evaluation group and they don’t necessarily do the evaluation. They coordinate the evaluation.

VELOSA: But it's the stewards. They [..?..] the system design stewards.

GRAY: They don't necessarily do the evaluation, they coordinate the evaluation.

BLOUNT: Yeah, that’s critical.

GRAY: They’re not, you know -- so the nice thing there is these can be information managers but not technical people.

BLOUNT: Actually I would argue this is the National Academies’ role right here. A stakeholder comes to the Academy with a hypothesis, they bring together --

VELOSA: Oh, like a TIGER committee for this?

BLOUNT: Well or this committee or any other committee. They come with a hypothesis and the role of National Academies is bring a bunch of people together --

LONG: Hopefully there’s way too much traffic going through there.

[Simultaneous comments]

VELOSA: There has to be a standing group though. It can’t be just to come together --

GOLDHAMMER: But this seems like a small group of people to me, you know.

GRAY: Yeah, it does.

LONG: What I’m saying is for every agency that’s interested in doing this kind of thing there’s a large number of hypotheses flowing through here being evaluated and meeting quarterly at the TIGER meeting isn’t going to do this for you.

PAYNE: And, you know, one of the fundamental flaws within DOD is that –

LONG: I think the TIGER can oversee some big process like this.

PAYNE: -- the science and technology folks, the senior scientists and technologists, they don't have a, you know, they get together but then they have coffee and they just talk hypothetically, have really no power, almost no power to get anything done. And it's actually the Acquisition Committee that actually has the power because they have the money. The money goes to them, you know. And even, they even control the DARPA money, you know, and so it's, what happens is, and part of the hypothesis evaluation, the hypothesis engine is they gather – and we're talking DOD – is they gather requirements, they gather, from the combat and command, which is like SOUTHCOM and CENTCOM, all that stuff, and they gather all the things from the intelligence community within the Department of Defense as far as, you know, concerns. And you need to have, where that comes together with science and technology has a role in it and right now it doesn't, it really doesn't. I mean, they give it lip service. They go, "Oh, this person's the Science and Technology Advisor," you know, and if they can get in and say, "Hi" and like, "Oh, yeah, what have you been doing?", "Oh, we're working on such and such, such and such, you know, and here's some decimal points" and then, you know, that political appointee's like, "Hey, man, nice talking to you. I'll see you next month." And that's really the problem is, from our perspective, is getting those folks in with the folks who actually write the checks. Because everything that you buy today in the Department of Defense you're going to take away from somebody else. That's how it is.

GOLDHAMMER: Yep, zero sum game. Yes.

PAYNE: There's a zero sum game issue. And I used to go to the guys who make decisions in the Department and say, "Hey, we need more money for this program." And they'll say, "Okay, where are you going to get it from?" I say, "I came to you. You know where it is?"

GRAY: I see this, I see this, the management of hypothesis evaluation, the hypothesis engine, I see this as being an entity, whether it's a contracting firm, whether it's some sort of internal organization within –

PAYNE: You don't want it to be a contracting firm.

GOLDHAMMER: Well no, I'm just saying but, you know, inside the, you know, whether it's a new sub-piece of the TIGER committee or something like that.

PAYNE: Well here's the answer for today. Today this will come from the Acquisition Committee, okay? What needs to be added in here –

LONG: Well the money will but the staff, you staff over there.

PAYNE: The money and the decisions and some of the hypothesis generation will actually come in there. But, you know, maybe DARPA. DARPA has some say, but – as far as where they want to go. But there needs to be

Transcripts were not edited.

more emphasis on the science and technology, the scientists and technologists, within the Department of Defense, have a say in that.

CULPEPPER: Let me say something though. I think one of the -- when I look at this I think of Hollywood and the whole market of Hollywood, right? And these things happen all the time in Hollywood and there's an entire ecosystem that's built up around it and if there's a way that you could replicate that ecosystem, you know, be it DOD, be it Department of Transportation, be it the private sector, finance, it doesn't matter, where you can basically have the -- because the enablers are the active and passive data feeds, right, and then a vested set of interested bodies who are generating the hypotheses, right?

GRAY: But see -- I didn't mean to cut you off earlier, Ken, but what I'm saying is we need to think of this as coming out of our report. We need to think of this as DOD, you know, and the Acquisition. That's great. That's one potential customer. The Federal Reserve, you know, somebody else could be another customer as well.

PAYNE: But DOD is paying for this.

GRAY: Well I understand that.

PAYNE: And the DOD wants to know -- because the Federal Reserve is different than DOD.

GRAY: Well, I understand that but the architecture of the system –

VELOSA: [..?..] DOD if it has multiple partners on this.

GRAY: -- the architecture of the system is --

GOLDHAMMER: I want to interject, I want to interject because I want to just kind of focus in a more practical matter. There are lots of things that we're saying that we're doing here and the conversation about who ultimately is going to pay for it or what that might mean is important but actually what would be very helpful right now is to figure out what exactly is the staff that does these things.

LONG: Right. So I don't think this is going to be staffed with acquisition officers, okay? It's the wrong kind of person, okay

PAYNE: I agree with you.

LONG: Okay? This is –

PAYNE: I'm not saying that's how it should be. I'm saying that's just how –

LONG: It will fail. I guarantee you if you put Acquisition people, this will fail.

PAYNE: But I want to put in context the way it is right now.

Transcripts were not edited.

VELOSA: But to me, this and this are the same people.

LONG: No, absolutely not.

VELOSA: They have to be 'cause they drive the -- They don't do it at –

LONG: No, absolutely not. The people that understand the, that have the scientific knowledge, the other knowledge here, are not the people generating the hypothesis.

VELOSA: They have to have the same scientific knowledge.

GRAY: Six, I would say six data analysts there. That's – I'm going to put a number. Six analysts.

GOLDHAMMER: Six analysts doing passive ID?

GRAY: Doing. Doing passive analysis and this is going into kind of what the other table had with --

LONG: [..?..] cell biology [..?..] --

CULPEPPER: Nah. I think you could do that, I think a team of three development oriented, totally development oriented.

[Simultaneous comments]

GOLDHAMMER: It's a small number of people but are there partnerships there as well? You've got to be doing all kinds of – or is this all coming from inside the government?

GRAY: No. I think there's partnerships. I think there's --

LONG: See this arrow here? That's the [..?..] and that's the CIA and that's the DIA.

GRAY: Right. I think you're getting input from analysts that are in other communities. I think you have another, you know, another two people that are doing the data mining of different online systems, you know.

VELOSA: Right. But you then have to have the hypothesis generation and you have to have folks with an ability to understand the technical issues as well as the objectives from the questions. And to me, I'm not sure I understand your logic about why you wouldn't want them to then be involved later.

LONG: I don't want them evaluating their own hypotheses. These guys, their job is to think up scenarios which may be a – you know, in IBM we call them "wild ducks", okay? These guys think up things and we have this whole set of here, you know, all of these guys here that take these

Transcripts were not edited.

hypotheses and say do these make any sense. You know, your job is to be a visionary and think of things that are possible.

GOLDHAMMER: We're not going to resolve this now so Paul, I think Paul has a comment.

SAFFO: I wish Harry were here 'cause he would support me on this. The secret sauce here in the Valley for identifying technology disruptors is really simple and it's called lunch. It is, "Hey, Darrell, let's do lunch" and we talk. It's lunch at the sun deck, it's social events and the biggest problem I see that the government has is everything's a goddamned pain in the ass to do in terms of, you know, forums to buy someone a beer. [General laughter] You know, it's really good form. And so I just, I throw this out because what worries me as we start getting down to this, it starts getting formal. And the top-level thing I would say is this is a small team of people total. I once had a secretary who was a born-again Christian and I was complaining about the politics in my firm and she said, "Hey, look at Christ. He had 13 partners and that was one too many."

[chuckles]

LONG: Ouch.

SAFFO: And so I would say, I would go the hypothesis you could do this entire thing with 12 people.

GOLDHAMMER: So I hear a general consensus that this is not a lot of people.

GRAY: No, it's not a lot of people.

GOLDHAMMER: We can decide whether it's the same people or not, we can solve that, but it's not a lot.

VELOSA: Okay, so we have a number here of 12 total for everything.

GRAY: I could go with 12, I could go with 12.

LONG: I could go with 12 too.

CULPEPPER: I could go with 12. And so the question is, you know – and I think you --

SAFFO: Or you can put 12 or less, 12 or less.

GRAY: And I think you divvy it up, divvy the 12 people up, based on what you've got going on at the time, what's coming in that you need to have done.

SAFFO: It's a small team of people and it's in the NAS model which, you know, let's face it. The National Academies, the way it does its work is the same way that, you know, Blanche Dubois in *Streetcar Named Desire*. "I have always relied upon the kindness of strangers."

Transcripts were not edited.

GOLDHAMMER: Are there any specific partnerships that you see as being critical to doing this with specific organizations?

CULPEPPER: Search engine. I would go search engine big time.

CULPEPPER: Search engine on this side. I think this is --

VELOSA: But to Darrell's point, the CIA -- I mean, it already exists.

GRAY: So search engines on that side. On this side I think you've got social networks, on this side I think you have social networks, I think you have special interest blogs, you know, so --

CULPEPPER: This is like cloud shields and like –

[simultaneous comments]

LONG: Yeah.

GOLDHAMMER: And then what about up here? Is there anyone, is there – you know, Stewart had the like, you know --Is there anyone, is there – you know, Stewart had the like, you know –

LONG: This is the big boss.

GOLDHAMMER: This is the big boss.

LONG: Yeah.

GRAY: This is, as Ken was saying, this is, you know, this is –

LONG: You know, the Customs Service, right? It's interested in --

PAYNE: I'm staying out 'cause I got too involved earlier.

GRAY: Okay, yeah, you got too involved earlier. No problem, no problem.

CULPEPPER: I think there is something else over here though, potentially. I call them gravity wells. They're big, they're portals that people are drawn to because they're connected to other people, right? And, but I think the long bet or the Long Now Foundation is actually, I'm not going to say it's the right one but it has many of those characteristics.

GOLDHAMMER: For up here?

CULPEPPER: Yeah, for up here. It bears that fabric, right?

BRAND: At Long Now we continue to be astonished by the impact.

[Simultaneous comments]

Transcripts were not edited.

CULPEPPER: Yeah, yeah.

VELOSA: And I would also argue that even the portals that connect them with the feds, the State Department and all that there, that would also have here --

GOLDHAMMER: This is an interagency, interagency?

VELOSA: Yeah, interagency and sort of --

LONG: Well certainly there's, you know, there's communication, right?

GRAY: Scientists don't do reality.

LONG: You don't want everybody doing the same thing and coming up with different answers and not telling anybody or you don't want to build another set of stovepipes.

GRAY: How many perfectly good hypotheses were killed by a collection of data?

GOLDHAMMER: Any other – just look at the table quickly. Any other resource requirements that you think are important before we wrap this up? We have a small number of people, we've got –

LONG: The hard thing that you're going to have dealing with this is inter-agency cooperation, okay? This one, it's a nice green arrow but this is hard, right? You need to convince NSA, you need DIA, CIA, to give me the information that I can look at to try to find the signal, right?

GOLDHAMMER: How many people are cleared in this system? You play in that world a little bit.

LONG: It depends on who this is, right? If this is the Customs Service it's different than if this is DIA.

GOLDHAMMER: But no, but since -- I mean, hypothesis generation was your idea. One question I have for you is like how many of these hypotheses are classified and get stored in a vault versus –

LONG: It depends on where this information comes from. If this is all open source stuff, then these guys are all unclassified. If this came from HUMINT then --

GOLDHAMMER: Then it's highly classified.

LONG: -- it's highly classified. So it really depends on the inputs here.

GRAY: I mean, any, yeah, 'cause any public data mining and stuff like that is [..?..].

[Simultaneous comments]

Transcripts were not edited.

LONG: If this is just going out to the Internet and reading blogs and, you know, whatever, then this is completely unclass. If this came through, you know, interesting ways then –

GOLDHAMMER: Any other final comments and we can otherwise head back to the table? All right. Thank you, guys.

Feedback to workshop participants in Appendix D.

Transcripts were not edited.