

NAC Technology and Innovation Committee Meeting

Jet Propulsion Laboratory

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Opening of Meeting, Introductions, Logistics—Mike Green, Executive Secretary

Mr. Green announced that members of the Explorations Committee would join the afternoon session.

Opening Remarks and Thoughts—Esther Dyson, Chair

Ms. Dyson welcomed everyone, noting that even though NASA has no approved budget, this meeting is worthwhile because the committee's recommendations for programs and expenditures will give NASA more leverage for the future.

OCT Update—Rick Howard, NASA Deputy Chief Technologist

Mr. Howard briefed the Administrator last week on new programs. Technology is central to the new human exploration strategy and opens opportunities for utilization of the International Space Station (ISS). The new Department of Defense Advanced Research Projects Agency (DARPA) -like Space Technology Program (STP) plans to spend \$5 billion over 5 years for 10 overarching, crosscutting programs. The President's recommended budget allows for 10 programs in 3 divisions—Early Stage Innovation, Game-Changing Technology, and Crosscutting Capability Demonstrations.

In FY2011, the Innovative Partnerships Program (IPP) merges into the Office of the Chief Technologist (OCT) and the IPP budget integrates into the STP budget. OCT has been allotted the money and content to put together a strategic portfolio. Goal #5—“Change culture towards creativity and innovation at NASA Centers, particularly in regard to workforce development”—implies accepting the challenge to take risks and accepting the fact that everything will not work as expected. Otherwise, the goals indicate dropping back into an incremental program.

- *Raymond Colladay*: It is early to think about how to stock programs. He found the hardest thing as Director of DARPA was stopping about 20% of projects that were not working and did not meet milestones. *Mr. Howard*: A fundamental tenet of all STP programs is that they are expected to start and stop at a particular time and at an expected cost. Annual review will indicate whether a program is working, as will size, schedule, and dollar limits. We expect to learn from our failures, and to move on to something else.
- *Ms. Dyson* concluded that, if you're not canceling 20% of programs, you're not taking enough risk. Responding to *William Ballhaus'* question, *Mr. Howard* asserted that OCT director Robert Braun has authority to cancel projects within the 10 programs without congressional approval. Furthermore, the review process is ongoing, but project reviews are probably annual. *Dr. Colladay* brought up another aspect, i.e., you have to have somebody to hand it off to. *Dr. Ballhaus* noted that the high-performing organizations are the ones best at terminating projects that are not working, likening it to early infant mortality. *Mr. Howard* agreed that this is a basic tenet.

OCT's job is not to tell Mission Directorates what to do with their technology, but to figure out what is dual use and crosscutting. OCT should not fund projects relevant to only 1 Mission Directorate.

- *Dr. Ballhaus* noted the need to rebut arguments from Congress. *Mr. Howard* saw 2 ways—technology push, which is much longer-term—no one knows how these ideas will apply and how disruptive they will be. It's longer-term seed corn. It takes 10 years or more to develop such projects before a Mission Directorate adopts them. We should not do them if we are not sure they will be infused and become real within 5 years or so. Innovations not infused will be replaced.
Dr. Ballhaus: That will create a lot of options that are not taken up. *Mr. Howard:* That is another element that has to do with size. Stakeholders also have to accept that 20% will not be continued, which is acceptable if people understand it and if they have enough other activities going on. If they have only 1 project, they are invested in making sure it works at any cost. *Dr. Colladay:* You need examples to use on the Hill of things that became necessary, e.g., the F-1 engine that enabled going to the Moon was developed long before that, and, you need to paper the Hill with white papers on them. *Mr. Howard:* We have good examples, e.g., microchips or the precursor programs that resulted in James Webb Space Telescope (JWST) mirrors (which they tried to kill).
- *Dr. Ballhaus:* What do OCT's 3 divisions do to research? *Mr. Howard:* This is a piece of a strategy put together for all NASA programs, so you have to look at all the new programs to see the place of this one. Incorporating crosscutting innovations is the responsibility of the program offices of the Centers. There's directive work and competing work. *Susan Ying* noted that Game-Changing Technology is the most DARPA-like, especially Game-Changing Development (LaRC). *Mr. Howard* added that this program needs constant change-over of personnel, not someone who has been at Headquarters for 20 years. In fact, they are now advertising for a 2-year-term (possibly extending to 4) Senior Executive Service (SES) positions for directors. After the 2 or 4 years, those people will return to wherever they came from. In response to *Ms. Dyson*, *Mr. Howard* said NASA is also moving its own people around, and they are adjusting staff size to the approved level (~50 people). They are planning stations although they cannot effect that role until Congress approves the budget.
- Answering *Dr. Colladay*, *Mr. Howard* said Early Stage Innovation is all competed, but that does not mean broadly competed. They want out-of-the-box Agency-level thinking about solutions. Evaluation may modify funding for the following year. Not all details have been worked out yet; much of that will be for the Center Director. The Center Innovation Fund replaces the Director's discretionary fund (to which no money was allotted). The OCT fund does not have to pay salaries. Previously, all civil servants had to charge their time to a program to get paid, but now they are going back to all civil servants being paid from a base pool (~\$60 million) as a base value. *Dr. Ballhaus* thought it would give Center Directors tremendous flexibility. But, said *Mr. Howard*, the Director sets the ceiling for staff size, although within that size there is flexibility to balance where needed to get the job done. *Dr. Ballhaus* noted that this does not

apply to JPL. *Mr. Howard*: They still have the Center Management and Operations (CM&O) type of budget; JPL is not officially a NASA Center, so they have to adjust.

- *Dr. Ballhaus* called attention to the third bullet for STP guidance, “Meet the Nation’s needs for new technologies to support future NASA missions in science and explorations...similar to the way NACA aided the early aeronautics industry.” The Administrator has clearly stated that whatever is done, exploration will have to be done with borrowed money, so unless it contributes to economic competitiveness or national security, the expense cannot be justified. *Mr. Howard* did not know the details—NASA policy was just made public. Responding to *Ms. Dyson*, *Mr. Howard* said the argument can always be made that you do not know the future benefits or lack thereof.

Dr. Ballhaus allowed that this could give the United States the lead in a number of areas. *Mr. Howard*: The technology we develop may ultimately have practical gains in the auto industry or elsewhere—you can’t tell. *Dr. Colladay*: You need some policy “top-cover” to enable you to do that, and it is not clear that you have that. The head of the Office of Aeronautics and Space Technology (OAST) found that even within the Agency no one understood what he was talking about because NASA had the attitude that they were all the country needed, so this has never gained traction. *Mr. Howard* agreed, saying recent history has only exacerbated that issue. Constellation was incremental and sucked money out of all other projects.

- *Dr. Ballhaus* cited a good example of where this was done at the National Academy of Sciences (NAS) in 1984: they competed for supercomputers and an airbus. *Ms. Dyson* thought they do not care about jobs. *Dr. Ballhaus*: There is also foreign competition if our leadership in particular areas is at risk.
- *Ms. Dyson*: Then they should let the private sector do lower orbit space exploration, which is the new trend. *Dr. Ballhaus* predicted that NASA will delegate mission assurance until close to launch and then pile on top of it to ensure safety. NASA has a history in mission assurance. We need to find a way to impose mission assurance without imposing industry standards. *Mr. Howard*: It is a delicate balance to ensure mission assurance, since industry does not have the track record. *Dr. Colladay*: Now (the basis to the establish the intent of the third bullet), there is an opportunity to aid industry. Advanced technology must support that industry, but it is not clear that the Office of Science and Technology Policy (OSTP) and the Office of Management and Budget (OMB) buy into that. And, this is important, particularly now when trying to establish staying power for STP.

Rather than being earmarked or Agency-directed, STP will operate under the guidance of a strategic plan, challenges, and roadmapping activities.

- *Dr. Ballhaus* called attention to “competitive peer-review and selection”—there must be a balance between core NASA capability and what is competed. But, you

cannot be assured that you have the indigenous capability you need if everything is competed. *Mr. Howard* agreed. Therefore not everything will be competed. Over the 5-year period, 70% will be competed to address that concern and to use core competencies the Agency needs to maintain. For some things it is better to have the NASA team involved. Now is the chance to get into the technologies that have been deemed important, but were never undertaken.

- *Dr. Ballhaus*: People spend most of their time writing proposals. *Mr. Howard* agreed that this has been a problem. OCT is streamlining the process to make it more efficient, and basing the complexity of the proposal on the size of the project. They need to figure out a better process so as not to waste people's time and money. *Ms. Dyson*: It would be nice to quantify the cost in person-hours of all these proposals, e.g., venture capitalists take more risk, but spend less money taking that risk. They cannot afford the transaction costs.

If a project is not being done for NASA or industry to use, they are not doing their job. The overarching goal is to reposition NASA on the cutting edge.

- *Dr. Colladay*: You will know you have arrived if at a budget meeting, someone interrupts, saying they have your prepared remarks; they just want to hear about your failures.
- *Dr. Ying*: If mission-specific technology is done at the discretion of the Mission Directorate, how do you assure there is overlap? *Mr. Howard*: That is one of the main functions of the NASA Technology Executive Council—all Mission Directorates convene to see if and where the overlaps are. Meanwhile, the Council is in continuous discussion with Mission Directors. OCT is now having this discussion with the Science Mission Directorate (SMD). Coordination and communication are critical.

The approach is that in the early stage everything is competitively selected; after a 6-month study, some ideas may be adopted by a Mission Directorate or other government agency (technology pull). Some will become advanced concept studies and will propose for another element; some will be directed into the next game-changing technology to be adopted or not. Entry points for competition occur at all stages—they are opportunities for infusion. In the first year, 40% of the STP line is IPP-related content, but over 5 years that decreases to 25%.

The President's budget gives numbers before civil servants' labor charges have been deducted. We need to look at agreements under discussion with Mission Directorates. A third of the money goes for existing programs.

- *Dr. Colladay*: What have the appropriation and authorization committees of the House and Senate done? *Mr. Howard*: 2 have gone to the House and gotten full funding. The Senate came in lower with some specific language as to how the money was to be spent. We have to wait until September to know how to spend and meet the President's goals.

- *Dr. Ballhaus*: Is anyone lobbying for support on the Hill? *Mr. Howard & Mr. Green* asserted that there are factions on all sides. This is not an isolated element in the discussion. It has to do with the balance of what is wanted throughout the Agency. It is a matter of how you split the pie and where you want the emphasis. No one is saying this is the wrong thing to do. *Dr. Colladay* took a more urgent view of the technology part of the \$19 billion because there are so many other interests being addressed. While nobody is against advanced technology, it is tempting to spend that money and intend to work on the technology later. Someone should weigh-in on the importance of advanced technology. *Mr. Howard*: Even within the Agency and in Congress, it is viewed as discretionary funding. We have to make the case that this is important, that it takes time, and that you have to invest early. *Dr. Ballhaus*: The challenge is to develop a good urgency argument. *Dr. Colladay*: But, you have a window of opportunity to convey a message about how we got to this situation with Constellation—we did what we knew how to do, and it wasn't good enough. It was a low-risk approach based on what we did before. *Mr. Howard*: Funding limitations imply a low-risk, incremental program. *Dr. Braun* has been talking on the Hill about this program and has gotten a lot of support. It's the right thing to do, but there are other pressures to fund other things, so it's a balancing act.
- *Dava Newman*: People and education are strong arguments, that is missing. *Mr. Howard*: The large percentage that is open competition addresses this. Plus there is directive work to maintain core capabilities in NASA. *Dr. Newman*: 1 to 2% should be given to outreach to younger people. It has to be part of the story. *Mr. Howard*: The intent is there, but the exact policy is under discussion.
- *Dr. Ballhaus*: Is there a 1-page document for people from universities to use to educate members of Congress? E.g., deans of engineering and physical science might be helpful, although they cannot be asked to do it. *Mr. Howard*: There is a 1-page description of each program and more, which can be found on line, and we can provide information. *Dr. Braun* has been trying to talk to the broader community in that area.

Technology will be demonstrated as needed. Discussion with other agencies has clarified their roles and lessons learned. STP needs both the NASA Technology Executive Council (NTEC) and the Center Technology Council (CTC)—both very important councils—because Mission Directorates don't know what goes on outside their own centers. Both NTEC and CTC have met twice and are trying to define program content and how to manage it.

- *Dr. Colladay* related anecdotal feedback that NASA is indeed creating an environment of cooperation and collaboration. *Mr. Howard*: We are working in the right direction, but can't really do it until we get funded. The governance model was approved in May.

Dr. Braun is the final authority on what gets cut or funded. OCT has received approval to proceed with establishing a management council. They do not want staff members burdened with Agency reporting and management. All but 2 programs have level-2

Centers; an advanced concept call will be open to all. OCT needs to decide what to put in the call for graduate student fellowships, but is otherwise ready to leap into implementation as soon as they get the go-ahead.

Open Collaboration and Innovation Model—Jeff Davis, MD, Director, Space Life Sciences, Johnson Space Center & Elizabeth Richard, Senior Strategist, Wyle

Strategic planning for 2007 resulted in the collaboration between the Space Life Sciences Directorate (SLSD) and Wyle. The main technical capabilities are space medicine, physiological and behavioral effects of space flight, space environmental monitoring, and human factors. Their mission is to optimize human health and productivity for space exploration.

- *Alain Rappaport*, referring to the vision statement, asked if they weren't already the world leader in human health, performance, and productivity for space exploration. *Dr. Davis* thought this was really about integrating all the potential partners to work on human systems. *Ms. Dyson* interpreted this as an invitation for partners to join world leaders.
- *Dr. Colladay* asked, now that ISS has been extended for a decade or more, is there any thought to revisiting the centrifuge? *Dr. Davis* said there had been some discussion of smaller centrifuges. *Ms. Richard* said they were looking at overall capabilities of ISS.

They have identified 60 strategies, and noted the most important, namely: adopt an integrated human system risk management approach (identify what we need help with); establish strategic relationships and collaborations (we could not afford to do this alone); develop and implement an improved business model; and enhance internal and external communication (which relates to everything). To develop a benchmark process, they worked with some 20 organizations to find best practices and got a broad-based view of how these organizations (all identified as good at benchmarking) did it. All participants said they could not achieve their goals unless they collaborated.

- *Dr. Ballhaus*: To what extent was speed, i.e., getting the service to market, a critical factor in collaboration? A culture of speed helps overcome bureaucracy. *Ms. Richard*: If a problem was worked on by the same community for many years, they can open it to the broader community in 90 days, which is very valuable for efficiency and cost saving. *Dr. Davis*: They were developing different strategies for portfolio mapping, trying to adapt some of those things. Speed was very important, especially in the drug industry.
- *Dr. Ying*: Was crossing borders part of this research? *Ms. Richard* said they didn't benchmark with international partners, but they hope to use the system with all international organizations for more knowledge exchange.

Most critical for anyone to succeed in collaboration was to change the culture, which requires time and effort. They are collaborating as part of their goal and because the

federal government has been pushing it, evinced by the OMB memo that requires agencies to further these principles.

- *Dr. Ballhaus:* Some 20 years ago, prizes were proposed. How is this different?
Ms. Richard: The 2 cannot be related, but the current administration is heavily promoting prizes. Recently legislation was passed to change the prize administration. *Dr. Davis:* But, they do have prizes within the portfolio.

Key strategies are integrating a human system risk management approach, engaging in alliances and collaborative efforts, and developing and implementing an improved business model. They want to do this competitively to make serendipity happen more often. The 65-component human-risk system (e.g., standards for bone loss or muscle loss) helped define the body of work. Then portfolio mapping will aid the decision for which way to go. They need to give prizes in a way that changes the culture. They ran pilots with 3 vendors: InnoCentive, Yet2.com, and TopCoder. InnoCentive is not just a platform, but a full-service vendor good at training and providing service afterward.

- *Ms. Dyson* asked about an Ideation award. *Dr. Davis* said they get a huge volume and they need to pick just one. *Ms. Richard* added if submissions don't meet criteria, they can reject them, but not all ideations can be rejected. Framing the challenge is the most important piece. *Dr. Davis:* They have a reduced a number of challenges to best practices and lessons learned, which gets to a higher level of abstraction.
- In response to *Dr. Newman*, *Dr. Davis* said there are 12 challenge owners, with NASA@Work having 15 or 20 more. *Ms. Dyson* wanted to hear more about the realities of finding people resistant to change and the challenges of that. *Dr. Davis* thinks culture change is partly top-down: people are co-opted into change, they are skeptical, but are now the best supporters. SLSD plans a second workshop on engaging more people. *Ms. Dyson* summarized: Force change upon people and then they become engaged.
- *Dr. Ballhaus:* How do you decide what elements of the culture you want to retain? You can waste billions changing everything, including what's working. *Dr. Davis:* It comes back to the framework. This is an "and" process. The trick is how they work together. They are just trying to put new tools in the toolkit to help solve problems, so incentives have to be aligned. *Ms. Richard:* To increase awareness, SLSD will have a lecture series on why collaboration is a good thing in various organizations. *Dr. Davis:* They will focus on the 12 challenge owners, starting with results and discussing what really works.

These tools have a global reach with more than 1300 solvers from 65 countries. Results include improved food packaging, a compact and effective aerobic and resistive device, and forecasting solar activity. The food-packaging award went to someone who is not a specialist in food packaging and who used material not normally used in this industry. Of the total of 6, 3 more (and a 7th with Langley) have been posted. By mid-September they will have compiled all lessons learned, and by the end of the year they will have 12 sets of lessons learned—theirs and ours—for each.

- In response to *Dr. Ying*, *Dr. Davis* said the intellectual property can stay with the solver, and government gets the freedom to operate the license, or it can set up something ahead of time based on requirements. When the solvers opens the project room, they open the first legal door, so they have to agree to the arrangement.

Yet2.com serves more of a match-making function. It is anonymous, but they are rethinking that. For bone imaging, they are working with 5 of the contacts (the technology need is now closed). Even negative information is useful, so it will be built-in by using this process. Again, they will have compiled 6 and 6 lessons learned by mid-September.

- In response to *Dr. Ballhaus*, *Dr. Davis* said Red Planet Capital had been eliminated in 2007, but there is talk of reinvigorating it. *Dr. Ballhaus* noted that stopping it was not a NASA choice. *Mr. Howard* agreed that it is under discussion.

TopCoder was presented by the Harvard Business School. Now Space Operations is thinking about having an Algorithm Institute. There is nothing unique about these tools and much of it can be generalized.

NASA@Work is a pilot of internal innovation through a collaboration platform: 2 challenges were allocated to each of 10 centers, so there will be some 35 challenges by the end of the year. The financial reward on the internal system is small, maybe a few hundred dollars, but the recognition is huge.

Among those who participated was a National Institutes of Health (NIH) fellow who had done some of this work 20 years ago. The Department of Health and Human Services (HHS) is ready to issue a request for proposal (RFP) for innovation for Medicare and Medicaid and has a new innovation center. They are also working with the General Services Administration (GSA). In future, they may have networks of networks. All of those organizations asked what resources are needed. They need a strategy at the beginning and analysis at the end, but also expertise in the middle.

- *Dr. Davis* responded to *Dr. Newman*: Within NASA you can team up, but that differs from external collaboration. In social science, combinations and collaborations or competitions are the most powerful.
- *Dr. Ballhaus*: Measurement might differ because they were originally hired to do research and enticing people to change roles could be problematic. *Ms. Richard* agreed that that experience is needed. *Dr. Davis*: Some senior scientists have been converted into global network people.

None of this is specific to space sciences. It goes back to mission and vision and the intension to provide integrated human health and performance. NASA needs a mechanism to coordinate human health efforts.

The Level-2 center is at implementation now. A member organization could be any interested entity, including a federal agency, ISS partners, industry, e.g., Nike, GE, Philips. The Web site will be launched by September 15, and by January they hope to do

in-person workshops. They hope to build on this to provide an Agency-wide approach. They have established a Collaboration on Human Risk Forum, which brings in partners around a particular risk. To build-in flexibility, they are building-in an indefinite delivery / indefinite quantity (IDIQ) contract so things can be modified as needed; therefore, they are not tied to fixed calls at certain times of year.

- *Dr. Rappaport* noted that part of collaborating is sharing data. *Dr. Davis* assured him that there will be data postings, and the primary activity of the center will be data-sharing, which will draw more people to work with us. It will have a “Risk-apedia” format.
- *Dr. Newman*: A critical role for senior scientists is mentoring, and in market opportunities and lessons learned, there would be willing volunteers. *Dr. Davis* had not yet identified these people, but they have talked about challengers as mentors. It would be a good adjunct to the lecture series. *Ms. Richard* cited an experience at Tufts where Legos were used to teach math and science without students realizing they were being taught math and science. They could mentor student teachers to do this. Furthermore, ongoing workshops can occur in many forms and can be teamed with industry. *Dr. Davis* noted the open collaboration forum in government now.

Centennial Challenges Update—Andrew Petro, Program Manager, Centennial Challenger Program

The Centennial Challenger Program is a participatory R&D program. Mr. Petro wanted to put the program in context and get feedback. NASA’s Innovative Partnerships Program (IPP) has innovation projects across all the Centers. One program was for a fabrication laboratory, which came from MIT with innovation ambassadors. It gives people a chance to build their own prototypes. NASA is one of the few agencies that has specific prize money. They are still using the \$10 million appropriated in 2005, but an additional \$4 million has been allocated in 2010. It is limited to U.S. entities, which becomes a problem since half of Mr. Petro’s e-mails come from other countries. It is an opportunity to find extraordinary people. Since 2005, there have been 19 competitions and they want to expand to include more students. Competitors use much more money than the prize gives them, but they get recognition. Other values of prizes include educating, inspiring, and motivating the public.

This year’s challenges, for a total of \$5 million, are: Strong Tether (August 13; they expect 2 teams), Power Beaming (Fall 2010; same height but increased speed), and Green Flight (July 2011; requires an airplane that can go 200 miles in 2 hours using one gallon of fuel). A request for information (RFI) for potential sponsors was posted in June. Other challenges to be offered are: Nano-Satellite Launch (placing a small satellite into Earth’s orbit twice in 1 week), Night Rover (solar-powered vehicle that can operate at night), and Sample Return Robot. Under OCT, this activity will be part of Early Stage Innovation.

- *Ms. Dyson* recalled a meeting a couple of weeks ago. *Mr. Petro*: We need external input, but there is strong divergence. Some say we should have large, ambitious prizes; others say we should break the challenges into components, e.g., the

astronaut's glove, which had a successful outcome, but few participants. Over time, the program can become larger and larger. Much of the feedback does not fit with the current resources, e.g., the satellite launch challenge is a stretch. Not every one will succeed, but NASA spends no money unless the technology works as intended. Many ideas are recycled over and over, and still we have the same list of ideas generated in 2003. We have to stay ahead of the near-term NASA needs.

- *Dr. Ballhaus:* How do you get innovative ideas out of the existing industry base? They have innovative ideas, but are not likely to share them because they need to generate hundreds of thousands of dollars. *Mr. Petro:* Big companies do not compete for these prizes, but corporations could imitate this process internally and could see if some types of challenges would apply. This prize initiative is not a good fit for large corporations, but they can be sponsors and by being involved can find talent. A program for younger people to compete raises problems for them within their industry.
- *Mr. Petro* explained to *Ms. Dyson* that what these companies get from sponsorship is positive public relations, involving a broader group of the public, and showing openness, but nothing tangible. The partnership NASA now has with Armadillo is a direct result of someone from JSC going to them; no prize money was involved. *Ms. Dyson* noted that Armadillo has a good culture. *Mr. Petro:* They tested their engine at White Plains and also used methane. When they had to modify the engine, they did so in 3 hours instead of 3 months—NASA was very impressed. It has a positive influence, and it's good to get NASA people interacting with these other cultures.

Mr. Petro invited feedback. The Web site will be updated as they go along.

Kick-off Joint Session with NAC Exploration Committee— Esther Dyson & Richard Kohrs

Review of the Human Exploration Framework Team—John Olson [for Dan Dumbacher, Director], Engineering Directorate, Marshall Space Flight Center

Doing things the way they were done in the past will not get us where we want to go. Therefore, in April 2010, the Human Exploration Framework Team (HEFT) team kicked off with a strategy to create a decision framework for human space exploration of multiple destinations in the Solar System. They developed 9 investment portfolios, priority being given to: commercial crew and cargo, ISS operations through 2020, ISS utilization for technology development, 21st century launch complex, robust technology

development, substantial robotic precursor program, and Heavy Lift Launch Vehicle (HLLV) development decision by 2015.

Initially they will focus on organizational structure and conducting the first full iteration of the process, which is planned in 5-year horizons, targeting Low Earth Orbit (LEO) in 2025 with Mars as the ultimate destination. They want to inform the FY2012 planning, budgeting, and execution process by developing a strategy that identifies requirements for technologies and advanced systems capabilities. To do this, they leveraged key design reference missions (DRM); relied on work already done by involving the senior experts involved in those projects; received guidance from stakeholders; and ensured that output was within the affordability, risk, and sustainability frameworks. The first 3 investment strategies are: initial technology emphasis, then human missions; early beyond-LEO human missions; and 2025 human Near-Earth Objects (NEO) mission (which is presidentially driven). Early beyond-LEO and NEO will merge 2025.

- *Ms. Dyson* asked about operational complexity and number of launches. *Mr. Olson* thought, in general, this would exhaust all U.S. domestic capacity. We must leverage economies of scale—this is not simple and straightforward. It's both good and bad. It weights reliability against number of automated rendezvous in space; balance is the key.
- *Bo Bejmuk* questioned “design references.” *Mr. Olson* admitted that these are representative cases and are therefore misnamed. *Mr. Reuther* noted that that is where program planning comes into play. *Mr. Bejmuk*: All the DRM are interrelated. You want a family of DRM that the figures of merit will serve. *Mr. Olson*: The real solution will be in between, with elements pulled from both.
- *David Longnecker* referred to chart 13: “Most technologies can be matured in 5 to 7 years.” He thought that seemed optimistic for human-based exploration technologies.
Mr. Olson: For each capability area, subject matter experts gave their best estimates. When they reach a refined approach, that becomes the direction; then they refine it again, which will drive earlier and more investment, perhaps in a phased way. As for cost readiness levels (CRL) vs technology readiness levels (TRL), they are comfortable with the first order, but this will inevitably have to be refined.
- *Mr. Bejmuk*: When will you know whether refueling on orbit is better for the country? Is the concept to spend more for a station in the sky and build smaller vehicles? What is the timeframe for having that answer? *Mr. Olson*: HEFT looked at 2 opposite ends of the spectrum. Balance turns out to be the key from a reliability and an operational risk sense. There are reasons to go to heavy lift, but it may not need to be super-heavy. They had to make recommendations to the Administrator, but they are still working on this and still talking to DoD, et al. Those decisions will have to be made in the near term as an Agency and a nation because they inform the 2011 and 2012 to 2016 timeframes.

Review of Planning and Formulation Activities for Crosscutting Capability Demonstration Programs—Prasun Desai, Acting Director, Crosscutting Capability Demonstration Division, OCT

The plan is for 3 programs focused on maturing to flight readiness of crosscutting capabilities that advance multiple missions to TRL 6 or higher: Technology Demonstration Mission Program (the largest budget item), Edison Small Satellite Missions Program (in collaboration with academia and small business), and Flight Opportunities Program (reduced-gravity environment). For these, 70% of funds are competed and 30% guided. Start and end dates must be defined to get continued funding. In addition to fees from Early Stage Innovation and Game-Changing Technology, they will also have external influences.

- *Mr. Desai* explained to *Dr. Colladay* that “flight ready” is defined as TRL-6, a demonstration in a relevant environment, not necessarily in flight.

As for user funding, 25% of life cycle costs are shared with the participants. They want to get technology infused into the missions, which implies that the customer agrees to use the technology and contribute to paying for it.

- *Dr. Ballhaus* asked about the preliminary design review (PDR) level of maturity: Then, as the project goes to critical design review (CDR), does the program team have to refine it? *Mr. Desai*: We just do the demonstration. *Mr. Howard*: Part of the 25% agreement is to define how far they have to go; otherwise you have another gap. *Dr. Ballhaus* recalled the Air Force’s 1995 technology summit in which they presented some 70 technology projects, but could only fund 4. This process, too, will certainly generate many options that cannot be funded—and, funding technology is funding options. *Mr. Desai*: They are using the equivalent of a Decadal Survey to determine which are funded, so there’s a buy-in from the Agency-level perspective. *Mr. Howard* added that another piece to the 25% is that if someone else wants the technology they can take it further. *Dr. Colladay* observed that no matter how carefully planned, there will still be a gap. Technology transfer is complicated and circuitous. But, laying it out methodically is better than has done in the past.
- *Dr. Rappaport*: Is the platform for innovation or for validation? There must be some form of progression, but that might engender 30 innovations that need to be flown to see whether they are worth anything. *Mr. Desai*: Technology has to be at TRL-5; 2 other divisions are doing the system-level development. *Mr. Reuther* added, there are small programs that address this.
- *Dr. Colladay*: “Demonstration” and “technology development” connote that you know what to expect, as opposed to testing in a real environment. This is “technology development in a real environment.”

The Technology Demonstration Missions Program will help bridge the gap by maturing system-level space technologies through flight readiness and mission infusion. They are looking for multiple partners who could benefit, e.g., Goddard theorized ion-propulsion technology in 1906, but an ion engine was not demonstrated

in flight until 1998; then Dawn launched with it in 2007—it made Dawn affordable. Similarly, aerobraking technology was proposed in the 1940s, first demonstrated in 1993 for the Magellan mission, and finally used in 2001 for Mars Odyssey. OCT wants to shorten this time cycle.

Key elements are that a technology must be crosscutting, system-level technology ready within 3 years, cost about \$150 million, and have cost-sharing partners. At least 25% of the total life cycle costs must be contributed by a source outside OCT.

Opportunities for participation will be open competitions of yearly calls for system-level flight test demos. To get an understanding of issues, OCT released an RFI May 27; it brought in more than 200 responses.

- *Dr. Colladay:* Does Exploration Systems Mission Directorate (ESMD) control another funding mechanism? *Mr. Desai:* Collaborators will be able to join all categories, including enabling technology and demonstrations.

They will be ready to release a broad agency announcement (BAA) October 1 (if Congress allows), which will consist of a 2-step process: a screening proposal (10 pages or less) and a flight demonstration proposal (50 pages or less). They want to streamline the process to follow the intent of 7120.5.

- *Dr. Ballhaus:* Rather than funding to the 70% level, they could fund more projects at 50%, but most of them would overrun costs. *Mr. Desai:* The final budget will influence that decision, so there has been no discussion yet.
- *Mr. Howard* responded to *Mr. Bejmuk:* The OCT is at the same level as a Mission Directorate and reports directly to the Administrator. The appeal process goes to the Administrator.
- *Nancy Ann Budden:* This is why our 2 committees wanted to get together—to understand space policy and its direction. It is clear that we will have to optimize whatever is available. There should be one space vision, but at least collaboration among divisions and their committees. A military example would be “war fighter needs,” which would have to do with saving lives. Using that model for “needs statements” might help NASA arrive at mutually collaborative statements to decide on direction.
- *Mr. Bejmuk* clarified that what the Russians have done with inflatable decelerators is common knowledge in the United States.

A problem is not being able to afford launch vehicle time, so small spacecraft programs try innovative things on a small scale to advance technology that can be used on a larger scale. The Franklin Small Satellite Subsystem Technology (in the Game Changing Division) is a level 3 and 4 that merged with the Edison Program to TRL 5 and 6. Key evaluation criteria are technical concept, technical merit, and project viability. The final selection is a recommendation made to the Chief Technologist. Cost sharing is encouraged but not required. It should coordinate with, but not duplicate, other federal small spacecraft programs. Flexibilities should work on commercially important issues.

August 9, NASA will have a town hall meeting at the American Institute of Aeronautics and Astronautics (AIAA) Small Satellite Conference at Utah State University in Logan, Utah. A BAA release has been drafted with a target release of October 1 pending congressional authorization.

- *Dr. Ballhaus*: One way to deal with not getting the desired amount of money is to cut all sections off the top or delete particular aspects. *Mr. Desai* admitted that this is under discussion, but they don't want to decimate the whole program. *Mr. Howard* pointed out that some things in the budget are set-asides and cannot be touched, e.g., labor costs. After that, they can discuss which projects to fund. *Mr. Reuther* noted that the budget is considered line by line, and *Mr. Desai* that 5 congressional bills in progress have to do with the NASA budget.

Flight opportunities bring together 2 former programs: Facilitated Access to the Space Env for Technology (FAST), which only pays for the flight; and Commercial Reusable Suborbital Research (CRuSR), which provides 3 to 4 minutes of microgravity environment for technology development and scientific and university research. The request for quotations (RFQ) due date is July 20, 2010. The program will competitively procure suborbital flights on commercial vehicles to develop standards in FY2011; for the Flight Opportunities Program (FY2012), participants bring payloads and NASA pays for the flight. In FY2011/2012, the parabolic flights will test technologies in a space environment that could simulate microgravity and the reduced gravity environment of the Moon or Mars. The next call will be in October 2010.

ESMD/OCT Technology Coordination—James Reuther, Director for Strategic Integration, OCT

Technology coordination and integration governance across the Agency is addressed through NASA Technology Executive Council (NTEC). NTEC is the decision-making body for all technology programs throughout the Agency. The Chief Technologist is chair, but membership consists all Mission Directorate Associate Administrators and the Chief Engineer. Strategic decisions are first brought to NTEC. Appeals are made to the Administrator. Integration of technology development across the NASA Centers is addressed through the establishment of Center Chief Technologists (CCT) and the Center Technology Council (CTC). The OCT's Strategic Integration Office addresses technology-related coordination and integration between OCT and the Mission Directorates and other NASA offices. The job is about coordination of technology with other Mission Directors. They are developing a framework document of strategies and how they relate to other mission strategies.

The CTC consists of a Chief Technologist from each of the Centers and represents OCT's extension to the whole organization. Often headquarters only looks at what is immediately in front of them, and this facilitates representation from each of the Centers, in the trenches, as it were. Each NASA Center's Director has appointed a Center Chief Technologist whose responsibilities have been defined. They will run in-Center competitions of what will be carried out. It is not just about technology, but about people. We need a young, charismatic workforce.

- *Dr. Ballhaus:* Any issues related to standard 7120.5 would have to go to Chief Engineer *Dr. Colladay:* Would any areas have to be adjudicated above this level? There is a healthy tension between push and pull. *Mr. Reuther:* Some of this was covered at the 2 NTEC meetings. Mission Directorates are only interested in what is necessary to execute their immediate tasks. The Chief Technologist's purview is to balance that tension.
- *Ms. Dyson:* How do you make sure people the Center Chief selected will be change agents. What ensures that this turns out to be true? *Mr. Reuther:* In the first year, distribution of funds will be aligned with the R&D workforce, but after the first year it will have a basis to evaluate how well each Center did innovation-wise. Spending money on infrastructure would probably not be innovative. There are many ways to build-in incentive. Another example is the fellowship program.
- *Dr. Colladay:* One necessity is having a management structure in place. On the other hand, what you are trying to do is create an environment for innovation, breakthroughs, serendipity. Are you reaching down in organizations to get perspective on how researchers see this structure? Are there escape hatches for breakthroughs that don't fall within this structure? *Mr. Reuther:* The frameworks document is still being assembled, but when it is finished, people will be able to see the entire path for everyone. It is a communication to everyone to make sure innovation is allowed to occur rather than imposing a structure that impedes innovation. They are not controlling solicitations or how Centers comply, but are giving Centers a free hand. They want to be able to transition through the various programs. In Game Changing there are seedling activities from which you could quickly move to the next level.

CTC members have significant technical expertise within their Center, other Centers, industry, or academia. The Center Chief Technologist must have the ability to think at a systems level to apply technological knowledge. Whether it's a full-time job will depend on the Center. At Stennis it is not, but at KSC it is.

- *Dr. Ballhaus:* In a major mission, JWST, e.g., who carries the burden for success? science, research, and technology (SR&T) is carried as options on a mainline project. *Mr. Reuther:* It's a mixed bag. JWST is more of an engineering challenge to get from TRL-6 to TRL-9. *Mr. Howard:* The goal is to figure out how to mature a technology and then infuse it back into a program. *Mr. Reuther:* Even within ESMD, foundational areas have been set up to make sure the necessary support is available to implement their missions.
- *Dr. Colladay:* In program definition, have conflicts arisen between bringing in the best and brightest, and generating and developing core competencies at the Centers? *Mr. Reuther:* Discussion on those topics has been heated. It is not easy and especially without clear guidance. We don't want to cut ourselves off from a path that does not get implemented. *Dr. Ballhaus:* Part of the model is to build a structure like the National Advisory Committee for Aeronautics (NACA), a

concept OMB and OSTP are encouraging. There is also the pipeline issue; NASA cannot absorb the numbers of students who will be pushed through the system.

The National Research Council (NRC) was hired in the Aerospace Technology Area Roadmap (A-STAR) process to ensure an independent review. NASA hopes to send a draft technology roadmap to NRC by October 30, NRC will then convene workshops of stakeholders and send NASA recommendations for improvement. There are 15 separate technology area roadmaps. OCT's framework document spells out strategies NASA will employ to develop technologies so everyone will know how they fit into the big picture. It must be updated frequently, and Mr. Reuther will designate someone whose job it will be to do that. They also need a representative to be sure all Mission Directorates keep OCT abreast of their activities.

- *Dr. Ying* asked whether they had authority to solicit international partnerships. *Mr. Reuther*: The roadmap and framework will serve as guidelines for where technologies fit best. Both will acknowledge such partnerships, but we have to follow rules on what kinds of procurement we can release. *Mr. Howard*: That should not be construed to mean that we are not looking for international partnerships.

In a few areas they have started making the correlations across the Agency, e.g., Space Optical Communications and Near Earth Technology Demonstration missions. All Mission Directorates are involved to make sure we have a coherent plan. Independent programs and projects would still be run out of the Mission Directorate. OCT points out the need for coherent plans among Mission Directorates, e.g., there are entry, descent, and landing (EDL) investments for large payloads, aero-capture, and forms of hypersonic and supersonic deceleration. We need a long-term roadmap to show how development efforts are defined. ESMD is looking at aerocapture, EDL, and a demo for Mars.

- *Mr. Reuther* assured *Ms. Budden* that OCT wants to be sure they are satisfying needs, but not overburdening or being duplicative. They are cautious about making these investments and maximizing synergies. They want to avoid past mistakes of pooling money and then projects never getting done.
- *Mr. Bejmuk* asked how much money had been spent inside and outside the Agency and what the ratio is for technology and innovation, e.g., on the Space Shuttle 20% was spent by industry and 80% by NASA. *Mr. Reuther* hopes for a significant effort within industry and academia. They are competing it to ensure that they get the best ideas; they are not being prescriptive about that mix. OCT programs are built on the concept of looking for the best ideas wherever they come from.
- *Dr. Newman*: Are these ideas prioritized? *Mr. Reuther*: The draft roadmap does not take into account available budget; they are just cataloging the technologies needed and where they will fit from a phased-mission standpoint. The second round (after NRC involvement) will consider cost of technology development. It is very difficult and usually not right when estimated with known technology, and is even more difficult when we don't know what technology will fulfill the

performance need. Relative costs among enabling technologies will be informing the discussion, although the roadmap will not define the budget. That exercise takes place with the Mission Directorate Associate Administrator at a program level. *Mr. Howard* added that feedback from NRC will provide NASA with information to find the right answer. *Mr. Reuther*: However, externals will not influence that *per se*. *Dr. Colladay*: Specificities will be a rolling window. The Decadal Survey has 51 unbudgeted roadmaps. *Mr. Reuther*: Our first step was to review all previous roadmaps to avoid repeating mistakes.

- *Dr. Ballhaus*: How will impediments be removed? There is no path to take an idea through a sole source into implementation. *Mr. Reuther* said a substantial number (70%) of activities will be competed. Industry has its own internal idea-generation process. One of the things we are doing is directed activities. And, “70% competed” does not mean 70% goes to industry; it could go to NASA—wherever the best idea is. We need to invest in ideas that have been around for decades to see if they are worth keeping around. We want to know if there are things we should be thinking about that will change the way NASA fulfills its mission. Whether that turns into a directed activity is moot.
- *Dr. Ballhaus*: There is no path to do system development with the process you describe. *Mr. Reuther* disagreed: 30% of game-changing and crosscutting activities will be directed by Headquarters. OCT is about technology demonstrations. If someone does not want to do that he must talk to the Mission Director. *Dr. Colladay*: It sends a message to industry that is influenced by their seeing that you have a well-thought-out plan. If they did not see a path of cooperation between technology development and missions, industry would not fund these projects. It is important to see the pathway between OCT and partner funding with the Mission Directorate. *Dr. Ballhaus*: How do you find pathways for an existing industrial base to capture the benefits of what they do now? *Mr. Reuther*: The RFP is structured so industry can detail what they would bring to the table. *Dr. Colladay*: The flip side is that OCT does not need to capture that information, but industry can discriminate. *Mr. Howard*: Game changing is another approach.

Exploration Systems Mission Directorate. New Technology Initiatives—Benjy Neumann, Director, Advance Capabilities, ESMD

The Exploration Systems Mission Directorate (ESMD) has been with the Space Technology Program (STP) developing technologies with broad applicability to support mission-specific technology needs. Programs in the budget request are: Human Research Program (HRP); Enabling Technology Development and Demonstration (ETDD); Flagship Technology Demonstration (FTD); Exploration Precursor Robotic Missions; Heavy Lift and Propulsion Technology; and Commercial Crew and Cargo Development. The first 3 fulfill the exploration research and development theme, which implies many more demonstrations than before.

HRP elements cover human effects, such as microgravity, bone and muscle loss, and living in a small space for a few years. ETDD is focused on demonstrations, e.g., high-power electropropulsion, and demos on helicopters, later advancing to more difficult

platforms. Foundational technology domains address long-range capability needs for multiple destinations. Its 22 projects were reduced to 10, e.g., how can we locate and extract resources on the Moon.

- *Mr. Bejmuk* was puzzled by the apparent fascination with NEO—we're talking about spending millions of dollars to look at a rock. *Mr. Neumann*: It is not as difficult as going to Mars and will serve PR purposes until we can get to Mars in 25 years. It's a step in the process of being able to do a grander mission. It's a shorter distance than Mars (which adds radiation and supplies) and it may be possible for humans, rather than robots, to do scientific research at NEO. *Ms. Dyson* thought NEO could be interesting; they're not that small and they could contain water. *Mr. Reuther*: One could argue that we have learned a lot about Mars already and that this is new. *Ms. Budden*: 15 years ago they compared going to the Moon vs Mars. At that time NEO did not fit NASA's mission—you couldn't land on one because there was no gravity, etc. *Dr. Ballhaus*: We need a clear crisp answer to that question once we obligate that much money and have to borrow half of it. *Ms. Dyson*: Before we go to a NEO, we would check it out.

Mr. Olson announced that on August 10 and 11, a meeting will be convened to discuss NEO, their technological challenges, and policies to defend the economics and to bring into an amalgamated response.

FTD considers the possibility that NEO may be a place for astronauts to live or store things. It starts in FY2011 with the existing civil service and contractor workforce. The budget will dictate the number of demos. An inflatable ISS mission module assumes starting small and growing to a larger system with life support. The systems we have today are not sufficient to get to Mars.

Human exploration capabilities are predicated on heavy-lift and propulsion technology and an emergency rescue vehicle. Explorations' precursor robotic missions theme defines what you need to know to be sure humans can go to NEO and Mars safely. A lot of coordination is expected with Science Mission Directorate (SMD). They might assign it to a Center to have a competition and maximize industry's involvement. Once they know what to invest in, they have 2 mechanisms: reference missions and OCT programs. The technology they are funding will be reviewed annually for whether they are the right technologies and whether they are game-changing.

- *John Kohrs*: The launch vehicle will consume a large portion of the budget.
- *Mr. Bejmuk*: Why are the Russians and Chinese so stand-offish? *Mr. Neumann*: The Russians are interested in collaborating on a lander. India is trying to develop a capability on its own. We are collaborating with them on the Lunar Reconnaissance Orbiter (LRO), which flew on their vehicle. *Douglas Cooke*: Both the Russians and Chinese attended a recent meeting. They flew instruments on Chandrayaan, although India has not collaborated actively. *Mr. Olson*: The Indians signed-on so now we have 14 countries.

- *Mr. Bejmuk:* If we want others to bring their money, maybe they should have an opportunity to do critical-path research. In addition, international treaties might work better than contracts. *Mr. Cooke:* The current NASA leadership is more interested in having this involvement. Almost all the technologies Mr. Neumann discussed are areas we have known to be important for many years. It is a change for where the new budget is headed, but it is all a function of how the budget is resolved. NASA has invested a lot in precision landing and hazard avoidance, conversion technologies for nuclear power, cryogenics, etc. These programs would accelerate with the President's budget.

Discussion and Recommendations

Discussion

Budget

- *Mr. Kohrs:* We can't recommend anything with no budget; we have to wait and see what will happen. *Mr. Cuzzupoli* was still not clear on what the program really is. After that is clarified they have to establish the budget for it, e.g, on heavy lift or another project. Things we should be doing, e.g., crew rescue vehicle. That has to be settled first.
- *Mr. Kohrs:* The President's budget has a plan they can implement. Now the Senate says we have to have a heavy lift vehicle by 2015, which is not possible. Furthermore, he heard that the way to keep programs going until the budget is approved is to lay off contractors. *Mr. Cuzzupoli:* Termination liabilities, risks, and uncertainties need to be settled.
- *Mr. Howard:* Whatever the level of the budget, there are things that cannot be touched, e.g., civil servants or the 2% mandated for Small Business Innovation Research (SBIR).
- *Dr. Colladay:* It seems that NASA is getting set up for another big gap between expectations and funding level. *Mr. Kohrs:* Expectations are not possible so 2015 (an objective in a presentation this morning) will become 2018.

Mission

- *Mr. Bejmuk:* ESMD calls this enabling technology. It is not clearly a mission and it is a 2-way street. Shouldn't a Mission Directorate have a more crisp definition of the mission? If ESMD defined its mission more clearly, would that bring about easier agreement about what to fund among the White House, the Senate, the House, and NASA? *Mr. Kohrs:* It's not a mission; it's missions. *Mr. Cooke* will get a report by the end of August that defines enabling technologies for the missions and which are most enabling. A lot of it relates to mass and working through the integration of those efforts.

Employment

- *Ms. Dyson:* Is it helpful to talk about the number of people employed rather than money? Funders are thinking short-term, and unemployment is a national problem. *Mr. Kohrs:* But, NASA should be employing more people because it has more money; we just don't like the distribution. *Mr. Cooke:* Jobs in one area come at the expense of jobs somewhere else.
- *Mr. Cuzzupoli:* This creates a morale issue because we are losing people from programs already. *Mr. Kohrs:* When we have a continuing resolution we should add words that would allow continuation. *Mr. Howard:* A continuing resolution with an anomaly and continuation is being discussed. About 400 resolutions are written every year of which about a dozen get tied to particular activities. *Mr. Kohrs:* The real problem is that it ricochets through all the vendors.

Programs

- *Mr. Kohrs:* Timing is the problem; there's no way that money can be spent in 2011. *Ms. Dyson:* We must figure out how to do this more quickly, but that cannot be done until they get the budget. The FY2010 appropriation stipulates not canceling anything or starting anything new. *Mr. Cooke:* The intent this year is to get as much planning done as possible, so projects are "shovel ready." There will be an employment gap before we can get projects ready, but we are trying to keep the gap as small as possible. *Mr. Reuther:* An unexecutable program is not help at all.
- *Mr. Howard:* Another factor is that these are competed activities, so we have to allow time for the RFP process.

The NAC Exploration Committee members departed.

Observations

- The Office of the Chief Technologist (OCT) should be commended for its outstanding efforts over the past six months in planning and formulating the new Space Technology program. The T&I Committee believes the mechanisms are in place for the Space Technology Program to move from program formulation to program execution once approved by Congress.
- The T&I and Exploration Committees support and applaud OCT for maintaining close communications and interactions with the ESMD, coordinating critical-path technologies and technology development required to execute a roadmap to future human exploration beyond low earth orbit (LEO). Because future technologies represent an area of overlap between OCT and ESMD, these interactions are critical to avoid duplication, cross purposes, and gaps. Such coordination should result not just in schedule and cost savings but also in better outcomes and effective execution.
- The T&I Committee was impressed by the Open Collaboration and Innovation Model being implemented by the Space Life Sciences Directorate at JSC. In particular, the InnoCentive, the NASA@Work Pilot, and the proposed NASA Human Health and Performance Center (NHHPC) efforts should be embraced, supported and spread in order to promote innovation, collaboration, and culture change across the Agency. Likewise, the entire Council was impressed with the TeamX collaboration process it saw during its tour of JPL.
- The T&I Committee and the Exploration Committee found much value in holding a joint afternoon session. Each Committee was exposed to new information and found great value in jointly discussing many important topics that affect both Committees and their NASA areas of interest.

Recommendations:

- The Technology and Innovation Committee recommends that NASA allow the OCT to begin program implementation activities for the new Space Technology programs. This should include the OCT requesting a budget anomaly to the forthcoming "Continuing Resolution," allowing the OCT to begin initial program implementation activities including the issuance of BAA's for the new Space Technology programs.
- The Council recommends that a small ad-hoc NAC group work with NASA to identify the top three most egregious productivity and individual initiative killers (starting with FedTraveler), and determine their costs not just in money but also in employee time. This group should then make recommendations for either eliminating/replacing the offending policy and procedure or software, or replacing it with a small pilot program to establish a best-practice benchmark that might let NASA break out of government-wide solutions that fail to meet the interests of the agency and its people – and provide a positive example to other government agencies.

Next Meeting

The committee was invited to go to Langley October 18–20, and could probably meet October 21–22. Mr. Green will check this out.

Public Comments

There were no comments from the public.

Meeting adjourned at 6:35 PM.

Appendix

Participants

Technology & Innovation Committee Members

Bill Ballhaus, *Vice Chair*
Ray Colladay, *ex officio*
Esther Dyson, *Chair*
Mike Green, *Executive Secretary*
Dava Newman
Alain Rappaport
Susan Ying

NASA Representatives

Dan Dumbacher
Jeff Davis
Prasun Desai
Rick Howard
Banjy Newmann
Andrew Petro
Elizabeth Richard
James Reuther

Human Exploration Framework Team (HEFT) Members

Nancy Ann Budden
Bo Bejmuk
Joe Cuzzupoli
Dick Kohrs
David Longnecker, MD
Jane Parham
Bette Siegel

Agenda

NAC Technology and Innovation Committee Meeting
August 3, 2010
Jet Propulsion Laboratory
Von Karman Auditorium
Pasadena, CA

Toll free call-in number: 866-731-6783;
Participant Passcode: 4359844

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| 8:00 | Continental Breakfast for Committee members | |
| 8:30 | Opening of Meeting, Introductions, logistics | Mike Green, Exec. Secretary |
| 8:45 | Opening Remarks and Thoughts | Esther Dyson, Chair |
| 9:00 | OCT Update | Rick Howard, NASA Deputy Chief Technologist |
| 9:50 | Break | |
| 10:00 | Open Collaboration and Innovation Model | Jeff Davis, Director, Space Life Sciences, Johnson Space Center |
| 11:00 | Centennial Challenges Update | Andrew Petro, Program Manager, Centennial Challenges Program |
| 12:00 | Lunch at JPL Cafeteria | All |
| 1:00 | Kickoff Joint session with NAC Exploration Committee | Dyson and Kohrs |
| 1:10 | Review of Human Exploration Framework Team | Dan Dumbacher, Director, Engineering Directorate, Marshall Space Flight Center |
| 1:45 | Review of Planning and Formulation activities for Crosscutting Capability Demonstration programs | Prasun Desai, Acting Director, Crosscutting Capability Demonstration Division, OCT |
| 2:45 | Break | |
| 3:00 | ESMD/OCT Technology Coordination | James Reuther, Director for Strategic Integration, OCT & Benjy Neumann, Director, Advance Capabilities, ESMD |
| 3:45 | Overview of ESMD New Technology Initiatives | Benjy Newman |
| 4:45 | Discussion and Recommendations | All |
| 6:00 | Public Comments | |
| 6:15 | Adjourn | |