



## NASA Advisory Council (NAC) Aeronautics Committee

December 3, 2013  
National Institute of Aerospace, Hampton, Virginia

### Summary of Meeting Minutes

**Participants:**

<b>First</b>	<b>Last</b>	<b>Organization</b>	<b>Role</b>
Marion	Blakey	AIA	Chair
John	Borghese	Rockwell Collins	Vice Chair
Michael	Bragg	University of Washington	Member
Mike	Francis	United Technologies Center	Member
Tom	Wood	Bell Helicopter	Member
Karen	Thole	Penn State	Member
Mark	Pearson	GE Aviation	Member
John-Paul	Clarke	Georgia Tech	Member
John	Langford	Aurora Flight Sciences	Member
Mark	Anderson	Boeing	Member
Tom	Irvine	ARMD	NASA Deputy AA
Susan	Minor	ARMD	Exec. Secretary
Jay	Dryer	ARMD	FAP Director
Ed	Waggoner	ARMD	ISRP Director
Doug	Stanley	NIA	Director
George	Finelli	NASA Langley	Aero. Res. Director
Susan	Gorton	NASA Langley	FAP
Dave	Bowles	NASA Langley	Associate Center Director
Cathy	Bahm	ARMD	ISRP Dep. Prog. Director
Stuart	Cooke	ARMD	ISRP
Luat	Nguyen	NASA Langley	Observer
Fred	Brooks	NIA	Observer
Rick	Young	NASA Langley	ISRP
Benny	Lunsford	NASA Langley	Observer
Odilyn	Luck	ARMD	FAP
Duncan	Mclver	TeCC and NAST	Observer

## **Morning Session**

The meeting was called to order by the chair at 9:14 a.m.

## **Introductions**

Ms. Marion Blakey opened the meeting and welcomed members and participants, including those on the phone. Ms. Blakey welcomed Dr. Karen Thole to the Committee. Members introduced selves.

Dr. Doug Stanley welcomed attendees to the National Institute of Aerospace.

Ms. Blakey said that the committee had a full agenda.

## **NASA Langley Research Center Overview by Dr. Doug Bowles**

Dr. Bowles welcomed members and participants to Hampton. He presented a brief history of NASA Langley Research Center, tying it to the formation of NASA in 1958. In citing Langley areas of competency and organization, Dr. Bowles said the Center was a very matrixed organization. NASA's Engineering and Safety Center is hosted at Langley and draws elements from across the entire agency.

In response to a question posed by John Langford, Dr. Bowles elaborated on the Langley budget, mentioning \$30 million in reimbursables in 2013; it sometimes has gone as high as \$60 million: "It's not just roads and commodes."

When John-Paul Clarke inquired about how facilities are treated, Dr. Bowles said that Aeronautics Research Mission Directorate (ARMD) programs pay for usage. It's borne by the center management and ops budget. Dr. Bowles continued by describing a 20-year infrastructure plan; Langley is about two years into that plan at present. The Center will be building much more energy-efficient facilities; will construct an integrated engineering services building; and, by reducing the overall infrastructure footprint – tearing down two square feet for every square foot Langley will build – the Center should save \$100 million over time.

NASA Langley Aeronautics Research Director George Finelli mentioned ARMD's Aeronautics Test Program that does sustainment of facilities. John Borghese said that the other really important investment is people and asks if the Center has devised a 20-year plan to manage future workforce needs.

In response, Dr. Bowles said that Langley decided the Center needed the same type of plan for its workforce. What is needed? The workforce is much more challenging than facilities. People may not leave after 20 years. Langley management is "using our best crystal ball ... And trying to identify the skills we may need." Langley will brief the NASA administrator in mid-December about Langley's progress in developing such a plan. The Center must also take account in the ongoing comprehensive digital transformation [occurring worldwide].

In response to a question from Michael Bragg about workforce downsizing, Dr. Bowles replied that that is part of Langley Center Director Lesa Roe's temporary assignment at

NASA Headquarters [to oversee a Technical Capabilities Assessment Team, known as TCAT]. He said managers are trying to take a look across the board. The agency has changed a lot over the last 20 years. Just retiring the space shuttle has made a huge impact. Looking at the workforce numbers right now, the ratio of civil servants to contractors is still about one-to-one, even though the overall numbers have dropped over the last 20 years. The challenge lies in trying to determine what is needed and match that to the right mix of skills across the agency.

Dr. Langford mentioned interagency collaboration and how necessary it is in this budget environment. How are the efforts being coordinated? Dr. Bowles referred the question to ARMD deputy associate administrator Thomas Irvine, who referenced the hypersonics research effort across agencies. NASA is still the keeper of a lot of intellectual property. The question is how to support that and how to efficiently transfer funds. The discussion about how not to duplicate efforts continues.

Mike Francis observed that such opportunities do exist, although they take work. Dr. Clarke said that the model that is being described a 1950s model. Are there any civilian applications in Department of Defense's mind? Mr. Irvine said although they pushed for it, they found none.

A discussion ensued about the ins and outs of hypersonics research and collaboration. Dr. Bowles said that Langley continues with individual initiatives, even as the Center collaborates, such as in rotary wing research. He discussed Langley involvement in Human Exploration and Operations (HEO), space technology and development, and in evaluating advanced technology.

Dr. Bowles discussed Langley's strategic alignment with the aeronautics strategic vision, including sustainable, high-speed mobility. He cited Langley's science contributions, and discussed risk reduction as it relates to the Mars Airplane project. There is no specific work right now, and no active program on the vehicle side.

Langley continues to support "911 calls": urgent, short-turnaround projects. Dr. Bowles outlined Langley's core competencies and its facilities. The Center's Unitary Plan tunnel will be mothballed and then shut down. In response to a query from Dr. Clarke about what facilities would be kept as part of the Langley 20-year plan, Dr. Bowles said that the 14-by-22 Subsonic Wind Tunnel and the National Transonic Facility have had significant investments and still feature unique capabilities. The 14-by-22 is the workhorse facility. Both are solid. For the 8-Foot High-Temperature Tunnel, Langley has an agreement with the Air Force to bring actual testing into place. In terms of transonics, that's a capability NASA is looking to replicate on the NASA side, vs. the Air Force side.

Dr. Clarke: "In the entire spectrum, when you shut down the Unitary Plan, are there any [speed-regime] holes?" Mr. Finelli replied, not necessarily, since NASA is part of the National Partnership for Aeronautical Testing, or NPAT. Mr. Irvine said that there were layers of answers to the question. The tradeoff with the Unitary Plan was its duplicative capability, when compared with a similar Air Force facility.

A discussion ensued about wind tunnel usage vs. computational fluid dynamics (CFD) analysis. Wind tunnel demand should stay at least level with CFDs for some time to come. Smart users employ both capabilities. Fifteen years out, managers have to determine what makes sense. There is substantial supercomputing capacity at NASA

Ames Research Center. Wind tunnels are still relied on to produce large databases. The right way to look at it is in terms of plugging into national assets. Nevertheless, there are concerns about being one-deep without any redundancy. In terms of open wind tunnels, the nation is getting close to the absolute minimum that the U.S. needs. Boeing is doing testing abroad, and NASA is sensitive to why companies like Boeing have done so. Ultimately it comes down to value. NASA is trying to be as cost-effective as possible. What value does the customer perceive he's getting in terms of both data quantity and quality?

### **Where Ideas Take Flight** by George Finelli

Mr. Finelli presented an organizational overview, a discussion of Traffic Aware Strategic Aircrew Requests software, known as TASAR, and an Aviation Safety Program overview. In terms of ARMD's Fundamental Aeronautics Program work at Langley, he cited research in drag reduction, rotary wing crashworthiness, and low-boom, airframe-shape design.

A discussion ensued about low-boom research, testing and validation, and a revised goal set. Bounding the design space would be helpful. NASA has involved other members of the community in same. Community noise standards are essential for practical overland supersonic flight. A limited set of experiments may occur. What boom would be acceptable, for example in rural settings where the standards may differ from urban? It's difficult to get the law changed for Mach 1-plus flight for commercial aircraft. Creating a boom that doesn't touch the ground is being looked at in the research. Much of that depends on the atmospheric. Internationally there is a different standard. It is possible to build a supersonic airplane in the United States for flight overseas. Questions remain about what the exact mission here is for NASA aeronautics. NASA's emphasis is on the research itself. NASA wants to inform the regulatory part of the government of the sonic boom levels and come up with a numerical value. There is a need to quantify the feasibility. What does it mean to demonstrate something in flight? What is the role of flight testing? NASA is in total agreement that a demonstrator would be necessary. The question is how NASA achieves that capability. NASA should be able to advocate for that. NASA Aeronautics needs to prioritize. The Committee agreed that a sonic demonstrator needs to happen.

Mr. Irvine said that, in terms of prioritization, if it is one of our strategic thrust areas, and it is, we're not prioritizing among the six areas. We know that it will require a flight demonstrator, and we are working on that. We don't have the final say.

Mark Anderson said that here the United States can advance its own interests. He cited breakthrough thinking and its necessity. There are real reasons for NASA to get involved in this. Other people won't do it. It isn't within their capabilities.

Dr. Clarke cited what's in the best national interest. What is the system solution to the problem? We need to collaborate and then move forward. Ms. Blakey cited the need to introduce this to the public and capture the public imagination. Mr. Finelli said that it's very much part of the strategy, mentioning Langley-resident research on the human perception of sonic boom in residential settings. Ms. Blakey said that was very encouraging.

Mr. Finnelli continued with an Integrated Systems Research Program overview, and cited the community noise experiment in 14-by-22 Foot Wind Tunnel. In response to question about the certifiability of hybrid wing aircraft (HWB), Mr. Finnelli said that NASA was examining various engine-mounting designs. Answering a question from Dr. Clarke about airport reconfiguration and ground infrastructure issues regarding the HWB, Mr. Finnelli said there were pieces of that throughout the entire research. NASA has been looking at implementability.

Mr. Irvine said that the question is interesting. You are climbing a staircase, but you have to take individual steps. Is this an advantageous configuration if you're looking at flight efficiency and environmental suitability? We should at some point try to consider [that] as much as we can. Dr. Clarke observed that the HWB could be very far off, especially considering the certification issues. Mr. Borghese said that if the HWB was certifiable, someone would build it and airports would be reconfigured. It would solve a lot of problems.

Mr. Finnelli said that NASA isn't only looking at one configuration. There is a stable of advanced concepts. Mr. Anderson said that this should be the heart and soul of what NASA does, to get stuff in the air and get the planes to the air shows

### **NASA's Rotary Wing Research by Jay Dryer and Susan Gorton**

Mr. Dryer cited the civil rotorcraft market outlook and market growth areas. Dr. Clarke said there is a new framework for investments. Investment in the military has been underfunded. Mr. Dryer responded by saying that there is a significant investment on NASA's part.

Mr. Dryer cited U.S. rotorcraft research roles, which are tied into military very closely. It could prove a double-edged sword. Mr. Borghese observed that Europe has been very successful in rotorcraft innovation. The U.S. original equipment manufacturers (OEMs) have programs of record and success on those platforms. The Europeans actually have a market-based and not a program-based effort. That's how you're successful.

Mr. Dryer said that the ARMD portfolio still supports other platform development. It can be easier to flow from the civil side to the military. Dr. Francis cited two Defense Advanced Research Projects Agency (DARPA) programs. There is out-of-the-box work there. He encouraged NASA's involvement. Mr. Dryer agreed and said that NASA remains engaged.

Dr. Langford indicated that you need to provide both money and leadership to contribute. He said he was concerned about the degradation of NASA into a supporting role, and mentions the advancing-blade concept. Those are the kinds of things that mean leadership. Mr. Dryer responded by saying that future vertical lift area is one of those areas NASA is leading in.

Dr. Langford: "Why not call it vertical lift rather than rotorcraft? [The rotorcraft designation] stovepipes it into one technology." Mr. Dryer agreed. Dr. Francis agreed. Mark Pearson said that "Eurocopters have a better mousetrap."

Dr. Langford said that the problem is what NASA has done in the 1970s hasn't been carried forward, even the work of the National Advisory Committee for Aeronautics

(NACA) work, and what NASA did in the 1960s: “This theme of leadership is what I’m really concerned about.”

A discussion ensued about conventional and non-conventional terminology. Rotary wing is a departure from “helicopter.” Names are important; there is power there.

Mr. Dryer said that ARMD is providing a vision for aviation. There are challenges from commercial rotorcraft for entry into service circa 2030. He described current common rotary-wing configurations and missions, and envisioned configurations and missions in 2030 and beyond. Autonomy is not currently part of the Rotary Wing Project. But ARMD is well aware of it.

Dr. Francis posed a challenge problem: an autonomous passenger-carrying vehicle, citing elevators and trams. Dr. Langford asked: “What do you need from NASA to keep doing what you [at United Technologies] are doing? The toolkit ... What’s holding it back? Maybe the answer is nothing.” Dr. Francis said that to do what we’re talking about here is “making the S-97 [the proposed Sikorsky S-97 Raider high-speed scout and attack helicopter] look like child’s play.”

Dr. Francis asked how ARMD is integrating the industrial age with the digital age. In partial reply, Tom Wood said that what NASA most likely has to provide is reducing the acoustic signature. The FAA is making the rules so you can be truly runway-independent. Acoustics is the thing that “comes back to haunt me the most.”

Mr. Anderson said that what he keeps coming back to is the appropriate role for NASA. In the case of vertical lift, lots of products are extremely good, but very limited in speed capability; or worse in speed, but good in hover. NASA aeronautics ought to be out in front of rotorcraft innovation. NASA is getting overrun.

Dr. Langford agreed, saying it was true across the board. Removing the regulatory environment means flying a demonstrator. That’s the burden of proof. There is a convergence of industry needs. Dr. Clarke said that ideally it would be great to have [a rotorcraft] fly as fast as a fixed-wing. What do you need to make that [a reality]? Mr. Wood cited the ARMD strategic vision and lack of mention of rotary wing. Mr. Dryer said that ARMD was looking at it in terms of more efficient transport.

Ms. Blakey said that there does look to be tremendous potential in rotorcraft research. Mr. Dryer said that speed continues to be an issue. Mr. Borghese said that ARMD’s rotorcraft research is very short term vs. what you need to be looking for. You need a separate mission statement. Mr. Dryer said that ARMD was in the midst of developing that right now. We are working some of these important areas. Icing is another component. Are we doing things valuable to industry today, and what do we work next?

Dr. Francis said that controlled flight into terrain is still the biggest issue. The autopilots aren’t terribly sophisticated. There isn’t much capability of operating in an object-rich environment where most of these vehicles play. Mr. Borghese said that there are existing solutions right now. There is very little interest in these systems in the U.S.

In response to Ms. Gorton’s presentation of research themes and the current portfolio, Mr. Pearson asked: “What bucket does noise go into?” Ms. Gorton replied that it was included in both advanced concepts and configurations and integration.

Ms. Gorton discussed challenges for future rotary wing aircraft, the technology benefit assessment study, and research themes and tech challenges. Dr. Francis asked why GPS-denied navigation was not on the list. Ms. Gorton replied that ARMD could add that to the list and downselect it to fit it into the budget. That could be an option. Dr. Francis said that as one shifts to a new direction, expertise comes into play. Mr. Dryer said that ARMD will work hand in hand with the NASA research centers on that. This will involve an evolution of the workforce. It's getting people to shift the focus. It's not easy, but new people will bring a new perspective. That must be balanced.

Mr. Irvine said that there is a revised strategy for ARMD. There are obviously organizational and structural changes that are needed to implement that strategy: "We have to get out of or de-emphasize some areas where we have strong technical capabilities. We feel we need to fully implement that new strategy and structure in the 2015 fiscal year." One of those teams has the workforce issue to deal with. "When you ask if we have a plan, I have to ask for your patience. We're actually developing that now. We'll do some kind of data dump at the next meeting to let you know what we're doing."

Dr. Langford asked about the National Institute of Aerospace (NIA) being tasked with the workforce problem. It doesn't look like the NIA has actually gone in that direction. Mr. Irvine said that he agreed, and that he didn't think the NIA has fully realized that vision. The civil-servant staff is pretty much fixed. There is flexibility in supplanting in-house expertise with contractor expertise, which is always an option.

Mr. Wood observed that bird strikes remain a big issue. The birds are getting bigger. That is a tough design problem. Mr. Borghese said that it's also a big issue for general aviation aircraft. Are you doing any work with hybrid aircraft? Ms. Gorton replied that ARMD is just starting to look at how they can be applied. Some NASA researchers have looked at hybrids with hydrogen.

Mr. Borghese posed a question about more efficient gear boxes and additive manufacturing. Ms. Gorton said the project is looking at it overall. Hybrid gears might be one area, since 50%-60% of rotorcraft weight is in gears.

Dr. Langford observed that rotorcraft integration in NextGen is "kind of a grab-bag of a bunch of other stuff." He commented on small unmanned aerial vehicle (UAV) systems and how the air traffic control systems handles that. It's really different than today's national airspace system.

Dr. Francis said that it was not just large aircraft, but more aircraft and more dense aircraft. It's a system-wide problem. That's something the FAA really needs help with.

Ms. Gorton discussed fiscal year 2013 key elements and areas of research, and recent examples of NASA research making an impact. Dr. Langford asked if there was pressure from dual-use technology. Mr. Dryer said that if one looks at the 2014 President's Budget, the question is whether NASA is too tied to what the military is doing.

Mr. Irvine: "There's a lot to do. We all know what the funding for NASA Aeronautics is. What is your portfolio and what are your priorities? Any part of our budget too closely

tied to the Department of Defense will be automatically scrutinized because it's not civilian. What is it that we're doing that is readily explainable to the nation's civilian aeronautical needs? That part of the budget will then be on the table for reduction or elimination."

Dr. Langford cited the budget-reduction pressures from both the civilian and defense sides. Dual use has saved NASA's budget over and over. Mr. Irvine said there was a request for the reduction in rotorcraft funding. ARMD wasn't happy with that and dead set against the glideslope reduction, and so fought back very hard.

An extended discussion ensued about the role of the Committee to advise NASA Aeronautics how to spend inadequate resources and how to get the resources up to where they need to be. Cutting ties with the military would not be financially prudent.

### **Afternoon Session**

Ms. Blakey reconvenes the afternoon portion of the Aeronautics Committee meeting, reminding members that part of the Committee's purpose is to consider the discussions in light of feedback to the administrator.

### **National Research Council Committee on Autonomy Research for Civil Aviation** **by Dr. John-Paul Clarke**

Dr. Clarke presented a statement of task, iterating participants and the study plan. The Autonomy Committee's first meeting took place on July 10-12 and the second on August 27-29. Dr. Francis mentioned the development of perception algorithms as being particularly interesting. A third meeting was held Nov. 13-14.

Dr. Clarke said that, while the Autonomy Committee (AC) members' opinions are scattered, people are starting to coalesce about what the issues are. He believes the AC will come up with less than a handful of technical priorities, and then another set of assurance priorities. The Committee is keeping in mind going from three crew to two crew. Dr. Clarke said to imagine if long-haul flights could be done with only two pilots on board. There are some interesting things to be had there. And how do you handle vehicles on the ground? Across all these areas are questions of assurance. They need to be tackled before the FAA can be convinced. In Dr. Clarke's opinion, those are the big themes.

Dr. Francis said that the composition of the AC reminded him of the old Congress: some real conservatives, some real liberals, but a lot of moderates. The result should be a set of research topics for the next 20 years. Dr. Clarke replied that his hope was that the AC will have substantial recommendations for the nation going forward.

Mr. Borghese asked that, given the immaturity of this new technology, would it be good to develop a knowledge base to know what's going on. In response, Dr. Clark said it was a good thought. The AC can't make recommendations regarding budget, but they can make recommendations regarding process. The horse is already out of the barn ... Bringing all these different vehicle types together is a big challenge. No one person can do it all. Aviation can't afford to make mistakes. There is a need to do a lot more up-front thinking.



Dr. Francis said that the Autonomy Committee won't solve the problem, but will set the agenda to solve the problem. He cited machine intelligence, and said the question for NASA is how does it focus its efforts? Dr. Langford observed that the last National Academy report that was important for the aeronautics industry was the flight test report. It was not an exemplary piece of scholarship, and was released before it was done. That has limited its impact, which Dr. Langford believes was a loss. He hopes the Autonomy Committee can release a finished report. In response, Dr. Clarke said Dr. Langford was absolutely right. The AC is pushing on toward the objective. The report will not be released before its time.

Mr. Anderson mentioned being on the flight test report committee, and agreed it didn't meet expectations. Dr. Clarke said the AC was going to try to achieve consensus. The timetable will not be allowed to be the determining factor.

Ms. Blakey asked if the AC had discussed in a general way the resources required to take this underway. Dr. Clarke replied that they haven't had an overt discussion about that. In terms of technology, there are people spending a lot of money doing a lot of things. It's not about spending 500 gazillion dollars to invent a whole bunch of new things. The budget issue has not been a high-level issue.

A discussion then ensued about what would be good government funding and what would be good private-sector funding. Dr. Francis said the AC is taking its collective knowledge and trying to achieve consensus; he believes it will be able to reach consensus. Dr. Clarke agreed and said he was very optimistic.

Mr. Anderson said that if the Autonomy Committee took an extra 60 or 90 days, that might be a good thing. The National Research Council might not like it, but it would be better for the nation.

A discussion then occurred about the need for time and doing a quality job, and assurance research as it resonates politically. There is a need to balance utility and convenience with privacy concerns. People are willing to give up anonymity if there is sufficient benefit. Other significant issues are trust and certification, and risk and mitigation.

Mr. Irvine asked about outreach to other industry segments. Any general observations about how these other sectors use automation? In reply, Dr. Clarke said that, in industrial sectors, people use automation when people can no longer handle the situation. Other places it's used so that people won't get bored. Then when a complicated situation is encountered, it's back to people again.

Mr. Borghese asked that, relative to the FAA, will there be any discussion about what their requirements will be? Dr. Francis said there's a shift in the way that this gets done over time. Machine intelligence is a different way to think about certification.

A discussion ensued about where the FAA is now and where they will need to be. A great deal of research needs to be done. The FAA will have to change, even as it continues its dual mission of both regulating and operating the national airspace system (NAS). That dual mission does not have to be a negative.

Ms. Blakey observed that it would require much effort to, by 2015, to get a remotely operated vehicle into the NAS. Dr. Langford said implementation won't move faster than the network moves. Mr. Anderson wondered how the Amazons and the Googles of the world will somehow seamlessly introduce unmanned aerial vehicles (UAVs) into the NAS. A discussion then followed about the practical impediments of introduction of miniature UAVs into the NAS. Disruptive innovation will drive the system.

Mr. Irvine mentioned how NASA's Unmanned Aircraft Systems (UAS) in the National Airspace System Project is developing air traffic procedures on how to operate small UAS in urban areas. There is a consortium of 20 companies that NASA ARMD will use seedling monies to fund. ARMD had sent an email to Jeff Bezos, who responded immediately. There will be a mix of industry, academia and entrepreneurial interests. A discussion then followed about the rapid development of UAS despite existence of rules and regulations.

### **Advance Compositions Project Planning Updates by Dr. Richard Young**

Dr. Young presented a problem statement, the technical challenges, a summary of a Meeting of Experts and a DARPA-National Science Foundation composites workshop.

In response to a query from Mr. Borghese about the cost of the final product not being an issue, Dr. Young responded that it did come into play. Project planning has focused on reduction of time, because time factors into cost. There will have to be a balanced approach and a way to enhance performance: reduced time and reduced cost.

Mr. Borghese: "Is the U.S. behind in composites structures compared [internationally]? Did that come up?" Dr. Young said, "No, because these companies are international. The concern was over bonded structures: quality and process control and the like."

In response to Ms. Blakey's question about issues in unitized bonded structures, Dr. Young said that because there's fear of contamination, there's almost no way to inspect the structure to make sure that it won't de-bond. Engineers are now using lasers in specific areas to make sure bonds are strong enough.

In response to a question from Mr. Borghese about test-sample coupons, Dr. Young said that, generally, scalability is the issue. Researchers are addressing that concern through tighter process controls. Nevertheless, that remains a "holy grail" challenge.

Addressing Mr. Borghese's question about contamination, Dr. Young said that was why fabrication will be moving toward greater automation. It's an evolution, as are ongoing quality control evaluations.

In discussing a partnership with the FAA, Mr. Anderson had a question about signature authority even if the FAA was not a voting member. Dr. Young said the FAA was making a financial investment and shouldn't be voting. Mr. Wood said that, in his opinion, that was "letting them off the hook." Ms. Blakey said such a role for the FAA was perfectly reasonable and appropriate. In response to a question from Mr. Wood – "What if it doesn't hold water with them later on?" Ms. Blakey said that it could evolve into an ARC: an aviation rules committee. At this stage, Ms. Blakey thinks this is what the Project wants. Dr. Young said that consortium participants are happy to know the FAA is in the meeting.

In response to a question from Ms. Blakey about the status of composites standards, Dr. Young said he wasn't exactly sure how to characterize that. There are two databases and standardized testing techniques to do characterizations. A discussion then ensued about characterizing loads and fatigue on rotorcraft, fatigue test articles and analysis pieces, and embedding flaws for discovery. One of the greatest vulnerabilities is in the analysis.

Dr. Young discussed a potential partnership with the Department of Defense, and presented the initial idea of and participants in the Advanced Composites Consortium. Dr. Langford asked what there weren't any small businesses on the list. Dr. Young replied that Project planners established criteria for those who are key players in U.S. industry in this area, taking into account the ability to cost share, fabrication expertise and experience in certification. A number of smaller entities may have had one and not the other. The ones chosen scored highly in every category.

A discussion then ensued about aircraft structural components only. Which will be the primary focus for the Project? Mr. Anderson observed that the development of this whole initiative was very strange. It must be really important to people in the composites community. Dr. Francis asked if the consortium membership would change over time, and Dr. Young replied that yes, it can.

In response to a question from Dr. Langford about how much money is NASA putting in [to the Project], Dr. Young said \$25 million a year for five years. How much money is going to the consortium is yet to be decided. Mr. Anderson said that it was enough money to do a technology demonstrator.

Mr. Borghese said that when the Project concluded after five years "you won't be able to say you did anything." Dr. Young disagreed; there could be a demonstrator. Dr. Langford mentions the Environmental Research Aircraft and Sensor Technology Project, or ERAST. In the 1990s, NASA did that environmental aircraft; four companies were chosen, and they were all small. The total budget was \$150 million over 10 years. It was one of NASA's huge industrial successes. Those companies now have combined revenues of more than \$2 billion. No new companies were even let in. The companies in the advanced composites effort will each do their own thing, and won't collaborate on a single vehicle.

A discussion then ensued about how companies will get involved and what that involvement could lead to, as well as development of methods that could lead to new regulations. Mr. Pearson said that the result would be getting new tools and processes. It's almost pre-competitive. These consortia are not new; its leverage for an investment. It's pretty impressive to get this list of companies.

Dr. Langford cited ERAST and each company protecting what they thought of as their own intellectual property. There was never the data sharing that was anticipated. Mr. Anderson said he remembered ERAST. He said it was "a phenomenal success. It gave us some great companies." He cited the promise of making better materials for the future, but contrasted that with lack of support for other noteworthy efforts: "What makes me grit my teeth is that if I proposed getting \$25 million for computational fluid dynamics or wind tunnels, I wouldn't make it past the first two [proposal] charts."

Mr. Irvine pointed out that, for at least 30 years, NASA has been involved with composites. The point has been reached where most aerospace companies want to use composites in primary structures. A generation ago that was in secondary structures. Designers of the Boeing 787 “Dreamliner” had to be ultra conservative, using “black aluminum” that was heavier because they had to be conservative. Better refinement of these materials would convey a huge advantage. One has to take a step, and this is a pretty important step. Everyone in the aerospace industry [ARMD consulted] was very strongly in favor [of the Project]. Is the consortium route perfect? Few things are. The pervasive use of composites is worth the investment.

Mr. Anderson said that, for the record, he was supportive. He still wondered why this effort was elevated above everything else in a constrained budget environment. Mr. Borghese said that, as a non-conflicted member, he believed this was a very important thing to do, especially seeing what’s coming out of Asia. Dr. Francis cited [Internet predecessor] the Advanced Research Projects Agency Network, or ARPANET, as one precedent. Mr. Pearson said that pervasive problems across industry require consortia.

Dr. Langford said that in the current budget environment there are a lot of things done in the past that must change. Mr. Anderson said that he knew how many resources are flowing into this problem from his own company. Mr. Pearson said it is fundamental tools and processes.

The Project will start with the passage of FY2014 budget. Under a continuing resolution, the Project could start vectoring some work and organization planning and some no-funds work with industry. Mr. Irvine pointed out that as long as NASA gets a budget, sequestration won’t affect this program. ARMD will take some reductions and then start the activity. Ms. Blakey wished ARMD good luck with the new initiative.

### **Public Comments:**

None.

### **Committee Deliberations**

Ms. Blakey asks the Committee for any further comments. Additional ones can be made during the meeting of the NASA Advisory Council next week in Florida.

Dr. Langford said he had grave concerns about what he just saw on this composites presentation. He cited reservations about lack of diversity in terms of the consortium, and grave concerns about the process and the results. To his surprise, there was no inclusion of small businesses and mid-size businesses.

Dr. Francis agreed: “It’s an awfully limited list.” The way to remedy it is to include composite firms that specialize. There’s a lot to be learned from what [startups] did wrong. There needs to be a way to make this effort sustainable. This is worth looking at more strategically.

Mr. Borghese said the ongoing rotary-wing effort is important to the future of rotary-wing technology in this country. He cited the cost-sharing philosophy in the European Union. He praised the technical challenges laid out. A capstone project to show at an air show would be very good. He would like to see additional people on the composites team.

Ms. Blakey said there seems to be real concern about dual use; perhaps it's an excuse to hold back on funding. She believes dual use is a great strength, especially at this point.

Dr. Clarke cited U.S. Army underfunding of rotorcraft research. It's critically important to have that research. Dr. Francis said that there are different reasons on both the civil side and the military side to pursue the same technology, like acoustics stealth/noise reduction. Mr. Anderson said he didn't see any impediment to NASA support of military research. Synergistic advances are very possible. He urged the Committee to get on the record in favor of dual use.

Dr. Francis said that ARMD's rotorcraft efforts will advance the NASA agenda. Dr. Clarke said that it really enhances mobility. Dr. Francis said that the term urban air power is non-existent at present, and he believes that coupling rotorcraft with autonomy is a good idea.

Karen Thole asked if there is a role for NASA to play in moving things from the military to the civilian arena even faster. Mr. Borghese said that going from military to civilian given ITAR (International Traffic in Arms Regulations) regulations [that control the export and import of defense-related articles and services] is a very hard thing to do.

Mr. Wood would like to include vertical lift/rotary wing in the ARMD strategic plan. A discussion then ensued about rotary wing vs. vertical lift terminology.

Ms. Blakey expressed approval of the autonomy presentation. A discussion about reviewing the autonomy report followed. That report should become public around April 2014, according to Dr. Clarke.

Mr. Anderson said that he thought events are overtaking [the Committee]: "The steady, stately academic process is giving way to people actually doing stuff." Dr. Francis said that autonomy is very young technology. The Committee's job is not to worry, but to set an agenda. Dr. Thole pointed out that Dr. Clarke had raised a question about resources [re rotorcraft research].

Dr. Francis and Dr. Clarke applauded NASA for taking on autonomy research. Dr. Clarke praised NASA Langley Research Center's strategy of infrastructure management. Mr. Borghese said he was impressed that Langley has a 20-year plan, not just for facilities, but for personnel.

Ms. Blakey returned the discussion to ARMD's Advanced Composites Project. Mr. Anderson said he thought NASA Aeronautics leadership has done a superb job of navigating some pretty tricky waters, and commended them for putting the Project into place. Mr. Borghese said the research is important to the continuing premiership of this technology in the United States.

Dr. Langford expressed doubts about whether NASA should be doing this work. It is a matter of priorities. He has much stronger reservations about not picking smaller companies, which is not endorsable. The Committee should know more about the process. He objects to the impression the results create. It was not conducted in a full

and open competition. If it is an important technology, innovation doesn't occur solely in the large OEMs (original equipment manufacturers).

Michael Bragg cited universities and NSF efforts in this arena, and suggested the committee take a look at the ERC process.

A discussion then ensued about previous consortia. The advanced composites project is modeled loosely on the AGATE (Advanced General Aviation Transport Experiments) and SATS (Small Aircraft Transportation System) consortia. There's not a one-to-one comparison. CLEEN (the FAA's Continuous Lower Energy, Emissions and Noise program) is a competitive proposal. The advanced composites project [call to participate in a consortium] was a competitive process put out like a ROI (return on investment). More than 20 respondents, and criteria were published.

Mr. Irvine said the consortium is set up to add members. There are Tier 1, 2 and 3 OEMs. NASA will not exclude anyone who wants to participate. Dr. Langford observed that the behavior in putting together the consortium is inconsistent with large-scale statements made by politicians and leaders that small business is crucial to the U.S.; there are no small businesses on the advanced composites list. He expressed a great concern about how information is shared. Expand the circle or deal more assertively with the intellectual property issue.

Mr. Irvine said NASA considers this activity to be in the pre-competitive arena. Catherine Bahm said it will be pre-competitive and disseminated; the group that will help develop articles of collaboration will define how the work will be done, including the intellectual property issues. Articles of collaboration will be ready to be signed, and it is ARMD's intent to expand the group. George Finelli said while there is yet no mechanism to set up funds, there will be ways to bring on additional members. Dr. Langford: "That sounds great but the incentives of the first six members will be to exclude others based on the limited size of the pie." Mr. Finelli replied that the intent is still the same: to work out the intellectual property details, and how modeling and validation testing will be brought to the table.

Ms. Blakey had questions about the Committee being briefed about the composites consortium. The Committee would need to know more if making an informed statement as to its suitability. Mr. Anderson suggested a private conversation between Ms. Blakey, ARMD associate administrator Dr. Jaiwon Shin and ARMD deputy associate administrator Thomas Irvine. Ms. Blakey suggested having a more complete conversation during the next Committee meeting, and mentioned NASA's general intellectual property philosophy and how it applies to the advanced composites consortium planning. Dr. Francis described the upside and downside of waiting; an interim solution would be the telecon. Mr. Anderson pointed out that the Committee doesn't have oversight authority, just recommendation authority. Dr. Thole said it would be helpful to know how other consortia are structured. Ms. Blakey suggested putting this on the agenda for the next meeting. Dr. Thole asks that the NASA Advisory Committee be informed about that questions were raised about the consortium. Mr. Anderson reiterated that he is general supportive of the objectives, but still has questions about the partnership model. Dr. Langford: "Our role is to at least ask the questions; it's governance in the sunshine. I'm a big supporter of small business."

**MEETING ADJOURNED** at 4:34 p.m.