Comments from Members of the Chartered SAB and SAB Liaisons on the draft report entitled *Science Integration for Decision Making at the U.S. Environmental Protection Agency (Draft 03/05/12)*

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Lead Discussants

Comments from Dr. Elaine Faustman

Chartered SAB quality review questions

1. Was the charge adequately addressed?
   The SAB "undertook a study to evaluate the extent to which science integration for decision making occurs at EPA and how EPA might strengthen science integration practices. Towards that aim the SAB made three recommendations: 1) "EPA should explicitly plan for science integration to support environmental decisions", 2)"managers should be accountable for making science integration happen, stating with problem formulation.." and 3)"EPA should increase support and training for scientists across EPA, especially in programs and regions, to strengthen the agency's capacity for science integration and recognize scientists' contributions in this area."

   To achieve this report the SAB Committee on Science Integration for Decision Making had a committee of 16 members (including the chair) and 5 liaison members. The committee received funding in 2009 and undertook an "extensive fact finding" process that included interviews with EPA personnel within all major program offices and all of the 10 EPA regional offices and "all other offices that support decision making." Appendix B of the report lists the offices and the report indicates that over 72 interviews were conducted with more than 450 individuals. This effort and the summary materials from these interviews represent a valuable resource to the agency for this and other internal inquiries.

2. Are there are any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?

This reviewer would not state that there are technical errors however this reviewer was disappointed in the uneven quality and several omissions within the report especially given the tremendously thorough data gathering exercise.

For example on page 1 of the draft letter to Administrator Jackson the authors make a very compelling argument in favor of science integration, evoking significant and meaningful concepts of "One EPA" and consistency with the recent NRC's report entitled "Sustainability and the USEPA". This is great but this reviewer did not find the analysis to support these statements and in fact for "Sustainability" the report seems to be extraordinarily silent on the major re-organization of the agency to achieve these goals. Surely these are significant changes and by the silence the report has a dramatic chilling effect on whether the committee believes or has determined faults in the direction and commitment to science integration. Sustainability is again mentioned on the last page of the report, page 10 but again with a similar lack of comments addressing EPA actions but more on reference to supportive external reports. This reviewer would request that at least some directed

comments and review of this is included. (Note sustainability is also listed in several other sections of the report i.e. page 5 line 10 but not addressing the points raised above.)

The reviewer was also disappointed in the text descriptions included in the draft report for the committees working definition of science as "any enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the world." Note that the origins of this definition included knowledge as well as the enterprise that builds and organizes knowledge. Is this omission significant in the committee's deliberations on science integration? Please clarify and modify report to be explicit.

This reviewer also noted that no reference to human health is given in the paragraph, lines 19 to 27 on page 1 of the report that set the key definitions and focus for the report. The report on line 20 states "In the context of the EPA's work, science involves knowledge and data that help the agency answer environmental protection questions." This is true but the "mission of EPA is to protect human health and the environment" and nowhere in this paragraph is use of knowledge to protect human health explicitly stated. Please add.

On page 2 of the report the committee presents Figure 1 as the framework that the SAB recommended in USEPA 2000. This reviewer would recommend some details on how this framework has evolved within EPA using illustrations from early use of problem formulation within the EPA ecological risk assessment guidelines in 1992. This does illustrate a conceptual commitment from a very early stage. Given this early use did the interviews reveal success stories resultant from this early conceptualization within ecological risk assessment groups?

This reviewer was somewhat surprised to not see the presentation of the improved framework for risk based decision making that was in the NRC, 2008 report. Did the committee deliberate on whether to include this newer framework? Again without adequate discussion the reader is left to speculate that the committee did not "like" or "support" this framework? Again please be explicit.

3. Is the draft report clear and logical?

The reviewer had detailed several items that need clarification above.

4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?

This reviewer supports the conclusions that the committee presents but requests that the clarifications listed above are added.

Besides the main recommendations, the report provides useful examples of science integration across the agency and regions. For examples of EPA organizations with successful scientific integration efforts the committee lists on page 7 lines 38 to 42 several significant examples. For this reviewer the example 2 of the program that "..identifies the

research needed to achieve its goals, meet statutory obligations and fulfill court mandates …" hit a key issue of proactive identification of missing as well as needed data a priori to assessment, provides a great example of preparing for science integration. This matches the reports discussion of EPA's Action Development Process (USEPA, 2011) where an analytical blueprint is used to identify plans for data collection and analysis prior to decision making and as a direct result of problem formulation.

This reviewer was supportive of listing the NAAQS review process as a good example where science integration works. This example also illustrated the need for frequent review mechanisms and supports the committee recommendation for the need of significant resources to accomplish this science integration.

Comments from Dr. Ingrid Burke

Were the charge questions adequately addressed?
There charge questions were not explicitly asked, but I assume they were:
"What is the extent to which science integration for decision making occurs at EPA, and how might EPA strengthen science integration practices?"
The three recommendations definitely address the charge questions, and adequately. I do have some suggestions below.

Are there are any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report? Is the draft report clear and logical?
The report is quite pithy and good. I have only a few suggestions.
There is a bit of language that makes it sound as though the decisions happen in the absence of science, which then is presented to support decisions. I recommend a little attention to detail with this language (I know that the committee did not mean it this way). I recommend that on page 3, line 32, the report say that "these program and regional offices, together with ORD, are responsible for integrating science to INFORM the environmental decision making by the EPA Administrator". (It says "to support", as though she makes the decisions then the science supports it). Ditto the next line….program and regional offices also play a primary role in integrating science to "support the environmental decisions delegated to them". The language needs to suggest that the science comes before the decisions.
I do not understand the language at the end of the box on page 5, that says "Health and ecological assessments are not integrated….". It is about no assessment of benefits and costs, and it is hard to follow and a bit opaque.
Also on page 5, the language about program and disciplinary silos begins immediately by stating that success is defined by staff and managers in terms of meeting statutory requirements and court-ordered deadlines. The following text goes right to the problems associated with silos. I don't see a direct connection between these ideas, though I acknowledge that both are issues. I think there's just a little reorganization needed here.

Are the conclusions drawn or recommendations provided supported by the body of the draft report?
I am frequently hung up by language and acronyms in the EPA world of reports and reviews, and do not like to quibble about small things (yet I am going to). The footnote 10, on page 8, suggesting an internal EPA science policy council in each program or regional office, is a great idea – but why "science policy"? In my view, this council would do the work of defining Figure 1 for each environmental problem, and identifying the science needed and how it will be integrated. This is less "policy" than it is the details of defining the integration. For clarity, I think "science integration" council would be good, because it sounds more like it is doing the work Figure 1, rather than setting a policy for how science will be conducted and used.
The recommendation on the top of page 9, involving an elaboration of the problem formulation phase of Figure 1, is absolutely critical. I feel this needs expansion, or emphasis in some way.
The material in Appendix D is terrific. It is too hidden back there. I wonder if a box inside this review would be better for emphasis?
Page 9, line lines 35-37. I think the suggestion is that scientists take time away from science to work on integrating science into decisions. The words "translation" are good, but I think some

examples of how scientists in EPA do this, as part of their jobs, would be excellent. What would the training consist of, and what would the criteria be for the incentives? We in the science world have real metrics of scientific productivity, but not so much metrics like this. “For instance, could one metric be “outreach” publications, that address the specific questions of the environmental problem (from Figure 1)?

Comments from Dr. George Daston

We were asked to address four specific questions as part of the quality review.

1. whether the original charge questions to SAB Standing or Ad Hoc Committees were adequately addressed;
2. whether there are any technical errors or omissions in the report or issues that are inadequately dealt with in the Committee's report;
3. whether the Committee's report is clear and logical; and
4. whether the conclusions drawn or recommendations provided are supported by the body of the Committee's report.

Question 1: The Science Integration report was prepared in response to a memorandum from then-Administrator Johnson, which did not follow the format of posing a series of charge questions that typifies most Agency requests for SAB input. However, it is clear from Administrator Johnson's memo that he wanted advice on how EPA can strengthen scientific assessments for decision making. He suggested that this could include considering EPA's organization structure and functions in light of how they influence scientific assessments, and how to integrate traditional human and ecological risk assessments with socioeconomic analyses, decision science, and technology development and assessments. Finally, he sought advice on how to attract and retain the best diverse technical workforce. In the proposal that was attached to his memorandum, the SAB was also asked to consider scientific leadership, consistency of scientific practices, collaboration across disciplines and multi-disciplinary approaches as ways of addressing how EPA might better develop and apply science for decision-making. In addition to this memo in Appendix A of the report, the report's introduction states that after conferring with current Administrator Jackson, the SAB decided to evaluate EPA's processes for integrating scientific assessment into environmental decision making, as previously recommended by the 2009 NRC "Science and Decisions" report and the 2000 SAB report on Integrated Environmental Decision-Making.

Given that there were no explicit charge questions, I think the best way to comment on the issue in the context of a quality review is to determine whether the committee addressed both Administrators' requests for advice on strengthening EPA science and science integration for decision-making. My opinion is that the committee did adequately address this request, both by reiterating recommendations from the previous SAB and NRC reports on how, generically, to promote an integrated approach to science assessments, and by providing a few more specific recommendations about planning, managing and training for more routine cross-disciplinary assessments. That said, I found the report to be lacking in detail, with conclusions often too generalized to be helpful. Given the number of interviews conducted by the committee, I would have expected to have seen more examples of where and how science was integrated successfully, and where decisions were not well informed because of a lack of integration.

Question 2: I found no technical errors or omissions in the report. As noted in my answer to question 1, I would have liked to have seen more details of the findings obtained from such a large number of interviews, and more examples of where integration of science has worked (or not). The only example that is described in detail is the ISA process conducted by NCEA for

criteria air pollutants. While this is a good example of integration across some disciplines, it is not the only example within the Agency. In some ways, it may not be the best example to highlight because the intensive, iterative nature of the ISA process is legally mandated. Given that many of the EPA managers who were interviewed determined success as meeting legal mandates or court orders, providing an example that is also legally mandated may be misinterpreted. I would consider adding more examples of where science integration has been successful. Perhaps this could include some site- or incident-specific risk assessments that involved ORD and one or more programs and/or regions. For example, I believe that the decision process for approving deepwater dispersant use during the Gulf oil spill involved integration of science from NHEERL, NCCT, and I would imagine from other federal agencies involved in weighing the value of using dispersants vs. not using them.

There are at least some organizational structures that are intended to break down programmatic/ organizational boundaries, but I did not see examples presented here. One example could be the Communities of Practice initiated by the NCCT. These are intended to be scientist-driven information exchanges and problem-solving structures. They have an open membership within the Agency. It could also be argued that the national programs and national program directors were established to connect science, across disciplines, to problems that may be common across offices and regions. Would it be possible to comment on whether this very well-developed organizational structure is working? If so, it might be a model for integration more broadly. If not, this would be useful for the Administrator to know.

Question 3: I found the report to be clearly and logically presented. I did, however, find the first full paragraph on page 8 to be remarkably wishy-washy. It was not clear to me as to whether what is being presented in this paragraph was a debate among the committee about centralizing science vs. strengthening the science in the regions/ offices, or is just a statement of options for the Administrator to consider. In either case, it would be good to have more of the pros and cons of either option, and to have a recommendation emanating from this discussion.

Question 4: I found the conclusions of the report to be reasonable, but would be more compelling if they were better supported with examples and excerpts from interviews. It is not clear to me that the second recommendation holding managers accountable for science integration will provide the desired benefit. My fear is that emphasis will be put on the process rather than the outcome. The goal is to have better outcomes, and it is our belief that, at least for complicated issues, integration across disciplines will produce better outcomes. Perhaps a better recommendation would be to reward managers for the robustness, consistency, transparency and scientific defensibility of their decisions, all of which are dependent on appropriate problem formulation and science integration.

The third recommendation includes a wholesale exchange of scientists between ORD and offices/ regions as a way of facilitating science integration. One could argue that this is a good way of lowering the overall quality of science and decision-making at EPA by ensuring that scientists have maximum breadth but minimal depth. Would it not be preferable to create organizational structures that facilitate tapping experts within ORD on a situational basis to work with an office or region on a specific issue? That would ensure getting the best of the expertise from both ORD and the office/region. I don’t think it’s necessary or advisable to have every

scientist rotate through different assignments. It simply isn't the only (or best) way to produce a highly effective organization.

Comments from Dr. Otto Doering

I came away from this report with the concern that it may not be focused in a way that communicates as best as we might. Part of this may be that it goes back more than necessary to the SAB report of 2000 on this topic. The current report team made a great effort in their interviews and investigations into this subject on the basis of EPA current culture and practices, and I feel that this effort and its results might have been more the focus of the report.

On page 1, lines 34-46, the setting up of the topic for the report utilizing the text from the 2000 report did not convey the issue well to me. I feel that the four bullet points on page 10 from the Ash report might have been an excellent introduction into what the overall concern was and the critical role of integrated science. The second paragraph of Administrator Johnson's letter lays out some specific charge topics that might have also been part of the introduction and organization of the report. This could have been supplemented with the material from the "Proposal" paragraph on page A-3. One might have started with Ash for the overall concern, then briefly summarized the key charges the committee chose to address from the Johnson letter, and then go into science integration. The definition from the 2000 report did not appear to be easy to understand clearly if one did not know something about it already. Examples would help! I also did not find the Figure 1 helpful in describing a doable process.

Where is EPA now, and where should it be? The Phase I Problem formulation seemed to start with the process almost assuming the problem had been defined. Phase I should certainly include scoping, both of the needs of the problem and scoping of the range of scientific talent and information necessary to deal with the problem. It is at this point that a management decision can be made about the degree and kind of integration necessary. I see this as a critical part of the process. There is a piece of this on line 8, page 9, and another on page 7 lines 39 and 40, but it is not integrated into the decision framework chart or into the critical discussion of integration.

Would it have been possible to diagram one or more current processes and then the target process (or institutional arrangements) that should be the goal? The mention of the Superfund on page D-1 indicates that there might be a process there that could be diagrammed as a successful process? I believe that this committee, with the experience of the interviews, could have put together a more meaningful figure or set of figures than figure 1 from the 2000 report.

Looking at the effort put into the interviews, I am concerned that there is just page 3 and then "findings" from the interviews. Pages 5-8 contain good useful material from the interviews, and the recommendations are reasonable as far as they go.

Are there first, high priority steps that EPA could take in terms of organizational structures and functions that would be good beginning points for action? What could the administrator do within the next month that would make a difference or set a difference in motion? For example, the dichotomy presented in the recommendation on page 9, lines 30-47 between scientific recognition by peers and behavior along the lines of integrated science may not be best encouraged by recognizing individuals who break the mold, but instead by recognizing and giving large rewards to units or teams that do it right. Also, saying that managers are accountable for something (and that something is difficult to define) in lines 20-22, may not get the job done.

Especially because this committee put in the extensive effort with the interviews and other investigations, it should have the authority to be as plain speaking as possible about specific things that need to be done to meet the Ash goals for the Agency and the specific points in the Johnson letter. It might even use those points more as the organizing force for the report. This committee should speak with authority and more clarity than the 2000 report.

Review Questions;

1. Not sure the charge questions were clearly stated. They should be.

2. I do not see errors, but could more have been gleaned from the interviews for the body of the report?

3. I believe that the language could be more forthright. For example, I found the 2000 report definition of integrated science tedious and not as clear as it might have been done by the committee with some examples from real EPA experience.

5. It may be that additional conclusions and/or recommendations might have flowed from the interviews and those plus the narrative data from the interviews might be incorporated into the report.

Comments from Dr. James Sanders

Were the charge questions adequately addressed?

The charge for this investigation and resulting report was quite open ended. The committee appear to have carefully considered the overall request, and developed a set of questions that were asked of individuals throughout the agency. The result was an excellent summary of the findings that resulted from these many interviews, and more than adequately addressed the original charge.

Are there are any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?

No. My only thought during this review was whether it was possible or valuable to append the actual agency responses (with identities removed). I am not sure that this is possible, or desirable. However, a great deal of effort went into the information collection, and I assume that the specific responses may hold some interesting comments. it may be possible that in some cases this additional detail would prove to be of value.

Is the draft report clear and logical?

Yes. I have a few comments below.

The letter to the Administrator is very brief. It needn't be much longer, since the report itself is short and to the point. However, reading the letter before the report, I wanted more information/explanation about each of the 6 findings and the 4 recommendations. I would recommend taking these out of paragraph form (lines 37-44 on the first page and 4-9 on the second page and displaying them as two, bulleted lists. In addition, I recommend that each of these bullets receive one more sentence to better explain the authors' points. A sentence from each of the explanatory information in the body of the report could easily be used here.

The body of the report is brief but complete. I do recommend that the authors consider numbering the 6 findings and the 4 recommendations. This would make them easier to read and to follow, in my opinion.

Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes. This report is very well done.

Other Comments

Comments from Dr. George Alexeeff

1. **Were the original charge questions adequately addressed?**

The draft report does not have charge questions per se. Instead the report represents the results of a fact finding activity of the SAB.

2. **Are there any technical errors or omissions in the report or issues that are inadequately dealt with in the Panel's report?**

I did not identify any technical errors or omissions in the report or issues that are inadequately dealt with in the Panel's report.

3. **Is the Panel's draft report clear and logical?**

The Panel's report is clear and logical. The report describes that science is an important component of EPA decision making, yet no program has fully implemented the science integration framework. Yet the report does not explain if any entity has intentionally tried to implement the policy. Or if simply the fact finding mission identified existing programs and determined how well they matched up to the implementation framework.

4. **Are the conclusions drawn or recommendations provided supported by the body of the Committee's report?**

Since it is unclear if EPA entities have attempted to implement the science integration framework, the uncertainty supports the conclusion to explicitly plan for science integration. Science integration needs to come from the top and science managers are in the best position to visualize integration.

I don't see the following recommendation as being supported by the report: ***EPA should increase support and training for scientists across EPA, especially in programs and*** 30 ***regions, to strengthen EPA's capacity for science integration and recognize scientists' contributions*** 31 ***in this area.***
This is because I see the integration happening at a higher level. Staff cannot be expected to make management decisions. So I would change it to ***EPA should increase support and training for*** **<u>science managers</u>** ***across EPA, especially in programs and*** 30 ***regions, to strengthen EPA's capacity for science integration and recognize*** **<u>science managers</u>** ***contributions*** 31 ***in this area.***

Comments from Dr. Joseph Arvai

1. Were the charge questions adequately addressed?

In my view, yes, and I am in general agreement with all of the specific points made by the review team.

2. Are there are any technical errors or omissions in the report, or issues that are not adequately dealt with in the draft report?

None that I can detect.

If I were to make one, small, suggestion it would be the following: that to improve science integration for decision making at EPA, it may be advantageous to look at better systematizing decision making at various levels/regions within the agency. Some businesses have begun to do this (e.g., BC Hydro in Canada; see http://www.corostrandberg.com/pdfs/Industry-Canada-SDM-Case-Study-Oct15.pdf), as have some government agencies (e.g., see the NOAA/FWS recovery plan for Atlantic salmon, the Department of Interiors adaptive management programs). Several recent reports (e.g., NRC 2005) and books (Gregory et al. 2012) gives some clues on how to begin systematizing an approach that leads to thoughtful choices around not just science integration, but also information integration and a robust structure for agency decision making.

National Research Council 2005. Decision Making for the Environment: Social and Behavioral Science Research Priorities. The National Academies Press Washington, DC.

Gregory, R. et al. 2012. Structured Decision Making: A Practical Guide to Environmental Management Choices. Wiley-Blackwell. New York, NY.

3. Is the draft report clear and logical?

Yes.

4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes.

Comments from Dr. Michael Dourson

- Were the charge questions adequately addressed?

The SAB was specifically asked to comment on EPA's current organizational structures and function concerning the development and application of science assessments in different EPA decision-making contexts. Furthermore, the SAB was asked for advice and recommendations on how the EPA might strengthen scientific assessments and communication of uncertainties of these assessments.

The current SAB report nicely describes improvements to EPA's process, but does not appear to address the specific requests noted above. For example, the SAB report makes no comment on current organizational structure and function, but rather recommends that EPA:

1. Explicitly plan for science integration to support environmental decisions.
2. Make managers accountable for science integration, starting with problem formulation and science assessment, in their own organizations and across EPA.
3. Increase support and training for scientists across EPA, especially in programs and regions, to strengthen EPA's capacity for science integration and recognize scientists' contributions in this area.

A likely response of EPA managers to these 3 recommendations is that "we already do these things, although we can certainly try to do better."

Not withstanding the value of these recommendations, the SAB report also does not appear to offer recommendations on how the EPA might strengthen scientific assessments and communication of uncertainties of these assessments. For example, one of EPA's biggest areas of science integration is its Integrated Risk Information System (IRIS), and the SAB report specifically excludes a discussion of findings on IRIS within EPA. This exclusion should be revisited.[1]

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[1] As SAB members may know, IRIS first started in 1986, as a mechanism to integrate "safe" dose values[1] among EPA program offices, after it was found that 39 of 40 values for chemicals derived by separate program offices were different from each other. Within 5 years, EPA had created IRIS to house unanimous consensus information for 500 chemicals. This remarkable turnaround came about through collaborative work among senior EPA scientific staff on two agency peer review work groups, and the commitment of EPA management to science integration. Different EPA offices proposed risk values, which were reviewed in monthly internal meetings; values with which everyone agreed were loaded on IRIS. Senior scientific staff among EPA offices interacted on numerous safe dose deliberations prior to work group review and younger staffers had training in preparation for agency work group meetings. During the early 1990s the influence of IRIS grew and the "integrated" risk values were being used in many regulatory and enforcement situations; states, industries, and other interested parties petitioned EPA to reconsider many values based on newer data and analysis. Unfortunately, EPA had few dedicated resources for such reconsiderations. Due to this intense scrutiny and the receipt of resources in the latter 1990s, EPA management began a process of IRIS consolidation. One of the casualties of this consolidation was the abandonment of the successful work groups, and the dwindling of collaborative spirit among agency offices soon followed. Several reorganizations of the IRIS process have been

The SAB might suggest that EPA reconsider the former interagency structure that lead to the creation of IRIS. Furthermore, SAB might recommend that EPA:

- Allow time in the IRIS schedule when key studies are ongoing, planned, or, under development; for example, we now have much better knowledge of perchlorate's toxicity due to over 5 million dollars of research since 1997; this knowledge has lead to a more credible safe dose.
- Ensure that the public listening sessions are directly tied to the external peer reviews, and that peer reviewers are present or aware of the points raised.
- Define criteria for use of EPA's Science Advisory Board or the NAS reviews; for example, these panels need to include a sufficient number of erudite risk assessment scientists, and preferably be chaired by one of them. SAB appears to be doing this in the formation of its CAAC.

More importantly, SAB could recommend that EPA staff both listen and implement peer review suggestions. For example, the single, most intense frustration on the IRIS process, made by many erudite scientists, both inside and outside EPA, is that EPA's IRIS staff will not adopt their scientific comments. Several of these folks have said that they see no point in further research on mode of action (MOA) because it will not be fully, or even partially, considered by EPA. This is particularly worrisome, since EPA's well-written cancer risk assessment guidelines[2] emphasizes MOA understanding in cancer assessments.

SAB could also recommend that EPA clarify the process for resolving scientific disagreements within the agency and between EPA and other agencies. Are key decisions made by consensus, or will one scientist have the final say? Perhaps more important, however, is the science integration among all participants. In the early days of IRIS, for example, scientists from different offices discussed the assessments and reached resolution on key recurring issues. This collaboration also assisted the development of EPA-wide risk assessment guidelines and research to improve the basis of risk assessments.

Direct communication and collaboration amongst EPA staff is essential to insure that the best science is incorporated into its assessments. In addition, scientific collaboration with all interested parties could propel EPA's science integration process, and the science and practice of risk assessment, forward to meet the needs of the 21st century. SAB is well positioned to assist EPA in this endeavor and the recommendations of this panel should be enhanced and more boldly stated.

- Are there are any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?

EPA staff's comments on its Integrated Risk Information System (IRIS) would be a valuable addition to the report.

- Is the draft report clear and logical?

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proposed since the late 1990s. Now, fully one quarter of all IRIS values do not reflect the latest EPA safe doses.

[2] U.S. Environmental Protection Agency. 2005. Guidelines for carcinogen risk assessment. Washington D.C. EPA/630/P-03/001B.

Yes.

- Are the conclusions drawn or recommendations provided supported by the body of the draft report?

The recommendations appear very reasonable, but perhaps somewhat limited. I especially like the suggestion to increase support and training for scientists across EPA, especially in programs and regions, and to strengthen EPA's capacity for science integration, perhaps with the re-institution of the IRIS workgroups.

Comments from Dr. David Dzombak

This is an impressive study in its systematic design and thoughtful interpretation of the survey results. I expect that it will be read with much interest by the EPA leadership.

1. Were the charge questions adequately addressed?

   Yes, the charge from former Administrator Johnson was adequately addressed.

2. Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?

   I did not identify any technical errors or omissions in the draft report.

3. Is the draft report clear and logical?

   Overall, the draft report is clear and logical.

   I do have some comments that pertain to clarity for the committee's consideration as the report is finalized.

   (a) The report does a good job of describing the distributed nature and different levels of decision making involving science at the agency. The three principal recommendations all are aimed at highest levels of EPA leadership, however, and that is not made clear either in the letter to the Administrator (next to last paragraph) or in the introductory text for the Recommendations on page 8.
   (b) In the second principal recommendation on accountability (page 9), there is no discussion of possible means of evaluating performance with respect to science integration. Some discussion of how an accountability scheme could actually be implemented, perhaps with reference to some examples from the specific programs in Appendix D, would clarify and strengthen the recommendation, in my opinion.

4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?

   Overall, the conclusions and recommendations are adequately supported in the body of the report.

   While the details of the interview plan and the interview protocol are presented in Appendices B and C, I was disappointed that no tabulated summaries of the interview results were provided. These results serve as the raw data for the analysis and interpretation presented. If the committee generated any such summaries, I suggest that their inclusion in an appendix be considered.

Comments from Dr. Bernd Kahn

My responses to the four questions are yes, no, yes, and yes, respectively.

Comments from Dr. Agnes Kane

This report presents a clear, well-balanced summary of an extensive review of integrated decision making as currently practiced at EPA. It is responsive to the charge questions and the four major recommendations are appropriate. The report also clearly identifies both strengths and weaknesses of EPA's current approach to science integration and decision making at the national, regional, and program levels. The fourth recommendation emphasizes incentives, recruitment, and exchanges of scientitists at various levels of EPA offices to facilitate development of this culture. However, specific examples for improved educational and training initiatives were not described. The underlying issue is that scientific disciplines are narrowly defined and there is limited interdisciplinary and transdisciplinary education at the undergraduate and graduate levels. It will be challenging for EPA to remediate this deficiency.

Comments from Dr. Nancy Kim

1. Were the charge questions adequately addressed?

   The charge for this project is defined very broadly and differs in that aspect from many of the reports the SAB produces. Administrator Johnson's letter states, "Please feel free to tailor the scope and depth of the study as appropriate." The last paragraph of the attachment also states that, "The evaluation would result in advice and recommendations on how the Agency might strengthen scientific assessments, communication of uncertainties of the assessments, and how the results are used. Areas for consideration may include: scientific leadership; consistent scientific practices; scientific collaboration with and between disciplines; and multi-disciplinary approaches for integrating natural science assessments with economic and social science assessments."

   The committee focused on the process of science integration and that was within its charge and options. It also provided practical advice in Appendix D. As such, the charge questions were adequately addressed. Science integration in the regions' permitting programs may be the most difficult for EPA. If the committee had any additional, practical advice to assist these programs, EPA may find it very useful. I particularly like the committee's pointing out some of the strengths of the Superfund program that provide examples for other programs.

2. Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?

   I did not detect any errors. See response to question 1.

3. Is the draft report clear and logical?

   Yes.

4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?

   Yes.

Comments from Dr. Keith Moo-Young

1. Were the original charge questions to SAB Standing or Ad Hoc Committees adequately addressed?

The charge questions were addressed by the committee. The committee did an excellent job of conducting interviews and compiling a set of recommendations for the agency.

2. Are there are any technical errors or omissions in the report or issues that are not adequately dealt with in the Committee's report?

The report is well written, and there are no omissions or technical errors.

3. Is the Committee's report clear and logical?

The report is clear and logical. The executive summary provides clearer justification on the purpose of the document.

4. Are the conclusions drawn or recommendations provided supported by the body of the Committee's report?

The conclusion and recommendation support the body of the report.

One point that can be emphasized is that the Agency needs to evaluate, assess and improve its scientific workforce over the next decade. As many of the staff reach retirement age, the agency will be faced with a reduction of its scientific workforce. The agency will not only need to train its current scientific workforce on science integration, but it will also need to replace the scientific workforce as they retire with qualified scientist and engineers.

Another major part of the process of science integration will be the training of policy and decision makers of the process of science integration. Outside of ORD, most program offices, regions, and support offices are managed and run by policy makers who may or may not have a background in science or engineering. As a result, training and development programs for policy and decision makers is mission critical for EPA to assure that it fulfills its mission of protection of human health and environment through the difficult balance of policy and science.

One additional comment is on page 4 line 8-9, where it states that EPA is both <u>a scientific and regulatory agency</u>. This statement needs to be reworded to state that EPA is "an agency that **integrates science into policy development with a mission to protect human health and the environment".**

Comments from Dr. Amanda Rodewald

Were the charge questions adequately addressed?

Yes, the report addressed the original charge/goal of the study. That said, I am unclear if the Agency intended to solicit very specific recommendations, perhaps akin to an action plan. As written, the report is quite general in focus, which makes it open to wide interpretation (e.g., providing training can be interpreted such that the efforts are token and insubstantial or well-conceived and transformative) and can challenge implementation. There is a list of specific ideas for increasing engagement and accountability, but these are somewhat hidden in Appendix D.

Are there are any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?

I found no technical errors or omissions, but I wonder if the report contains sufficient detail to lead change.

Is the draft report clear and logical?

Yes.

Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes.

Comments from Dr. Jerald Schnoor

The normal Quality Review Questions and my responses are shown below:

Question 1: Were the original charge questions to SAB adequately addressed?

Because it is an Advisory, there were no charge questions posed, but it is clear that the report has fulfilled a useful purpose. It seeks to provide insight and advice on how science integration occurs at EPA, and how it could be strengthened. In this respect, the report is wholly successful.

Furthermore, the SAB Committee commented on EPA's scientific leadership including best practices for integration, collaboration across disciplines, and the expertise required to integrate science and to assist in quality decision-making. Once again, the report is on the mark.

Question 2: Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the Committee's report?

I found no technical errors in the report. And there are no glaring omissions, but I will comment on a couple of areas in the report that could be elaborated.

- **"One EPA"**. Several places refer to "one EPA" as an anthem for assessments that integrate information and analysis from many disparate parties including EPA program offices, regional offices, decision makers, the public, and various stakeholders. I may have missed it, but I was wondering from where this phrase originates? It is a powerful mantra which emphasizes the point well, but I found myself wanting to know more.

- **Integrated Environmental Decision Making.** The SAB Committee is recommending that EPA follow the framework on science integration established by earlier reports (SAB, 2000; NRC (2009)). This framework (Figure 1) consists of Problem Formulation; Scientific Analysis and Assessment; and Science Implementation and Performance Evaluation. The report supports using data and knowledge from many fields and purports to represent a new way of thinking to reduce risk. It is a logical framework, but is there any new evidence since the release of the previous reports that it really can work?

- **Decision-Making at EPA.** The report is about integrating science at EPA for better "decision making". But there is really very little in the report about how integrated scientific information should be used to make better decisions and by whom. Good ideas are presented for the process -- the "integration of science" across the Agency -- such as the use of integrated science plans, integrated assessments, and risk/exposure/policy assessments. But not much is included concerning how to actually take that data-to-knowledge (D2K) and use it to inform quality decisions. Also, the report mentions "environmental problem solving" as the goal of science integration for decision-making, and it would be good to re-emphasize that we should "begin with the end in mind" to protect human health and the environment. Should it

really take decades to determine an IRIS assessment for dioxin? How can we prevent that in the future?

- **Workforce.** The report makes the excellent observation that EPA has 6000 scientists involved in research and assessments throughout the Agency and only 1300 of them reside in ORD. But a broader point is that EPA has a *total* of 18,000 employees, and I think non-scientific staff must also play a role in integrating science for EPA. Is there any guidance for them? Also, some small fraction of the 18,000 is the actual decision makers. Who are they? How many – in which offices? Only the Administrator is mentioned in the report specifically. Is there any guidance for decision-makers to use the integrated scientific information wisely? As the report states, law, politics, policy, and values are also involved (I might add economics and technological feasibility). A couple of successful examples would help to illustrate the point.

- **Physical and Digital Proximity for Enhancing Science Integration.** The report does a good job of bolstering the first two elements of the Framework for Science Integration (Figure 1) by recommending better planning for science integration, holding managers accountable, and increasing support and training for scientists across the Agency. One constraint with which the report does not deal is the geographical distance among the various scientists within and without the Agency. Can any advice be given how to overcome this difficulty? I am reminded of the popular management book, "In Search of Excellence", where the point is made that the quality and frequency of interactions among co-workers decreases exponentially with distance between offices. Perhaps there are suggestions (including novel electronic means) to overcome these difficulties? Certainly, travel funds, joint meetings, collaborative projects, multi-authored papers, consortiums and demonstration projects are all needed.

I do not consider these points as criticisms of the report in any way, nor omissions that must be addressed. Rather they are points that resonated with me as I read the report for which the SAB Committee may wish to elaborate (or not).

Question 3: Is the Committee's report clear and logical?

Yes, the report is clear and logical. I appreciated its brevity (15 pages) and the quality of the writing. It is of a length and quality that will be read and (hopefully) acted upon.

Question 4: Are the conclusions drawn or recommendations provided supported by the body of the Committee's report?

Yes, the conclusions and recommendations contained in the response to charge questions are supported in the body of the SAB's report.

Comments from Dr. Gina Solomon

This report clearly represents a lot of work. I was very impressed at the number of interviews conducted, the number of EPA staff contacts, and the breadth of the interviews throughout the agency. Given the extent of the information collected, I was hoping for a bit more in the final report, including some more examples, selected quotes from EPA staff, and specifics of decision processes made using the status quo, with a description of how these might have been done differently. The report is perfectly acceptable in its current form, but it is a bit disappointing and may not have the same level of impact it could have, without more specifics. If I were an EPA staff person who spent time carefully thinking through and responding to the extensive questions, I would feel that my input was perhaps not reflected in the final report. It's also not really clear, from reading this report, how this system would work in practice. It appears possible that it would further delay already cumbersome EPA rulemaking processes, so it would be helpful to have more in the report about how this would help to streamline EPA processes instead of adding another layer of complexity.

Were the charge questions adequately addressed?
The charge questions were a bit unclear and were not laid out in an obvious way in the report. The only charge statement seems to be "to evaluate EPA's processes for integrating scientific assessment into environmental decision making" (p. 1, lines10-12). This is admittedly a broad charge and it might in retrospect have been helpful for the SAB committee to work with the Agency to define a set of clearer charge questions. I'm not sure how to respond to this question, since I think that the charge is over-broad, but I guess the report does address the question, to a fairly good degree. The report is strong in that it builds on the recommendations of the SAB (2000), and the NRC (2009), and lays out a clear conceptual framework in Figure 1, that is useful and is the basis for the main recommendations in the report. Again, as stated above, the report lays out a conceptual framework but is a bit short on specifics and on a rationale for how this will help EPA do its job more effectively. Some of the specifics are presented in Appendix D, and this short appendix could potentially be integrated into the report itself instead of being relegated to an appendix.

Are there are any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?
Not that this reviewer noted.

Is the draft report clear and logical?
Yes

Are the conclusions drawn or recommendations provided supported by the body of the draft report?
Yes

Comments from Dr. Pamela Shubat

The SAB Committee on Science Integration in Decision Making Report reflected an immense amount of work, was concisely and well written. Congratulations to the committee on an informative and readable report.

1. Were the charge questions adequately addressed?

The committee developed a plan to address the questions from EPA and the report shows that the committee fulfilled that plan. Since the letter and attachment from past Administrator Steve Johnson did not specify a set of questions, the committee articulated the concerns and questions, and developed and carried out what appear to be appropriate interviews to answer the questions.

2. Are there are any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?

Some of the concerns raised in the original letter could not be addressed (were not included in the charge question that was developed), which is understandable. One concern in particular, that the segregation of scientists and research "can result in the duplication of effort as well as conflicting scientific approaches to the evaluation of similar environmental agents by different offices" , has been apparent in the way that various programs have adopted and interpreted agency policies and practice. The committee addressed this, in part, in noting the barriers that disciplinary "silos" create (page 5 of the report). The committee noted that such barriers may hinder the integration of new scientific information into decisions. Adoption and integration of new scientific approaches and guidelines across the agency could be a measure of the success of science integration. Cross cutting offices and activities (such as the Risk Assessment Forum or the Office of Children's Health Protection) are well placed organizationally to evaluate the success of multiple programs use of new science and applications. The OCHP for example examines the decision-making activities (e.g., review of rules and regulations) of the agency for the approaches used to integrate and use guidelines around children's health.

3. Is the draft report clear and logical?

The report is very well written, very well laid out, with logical conclusions.

4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes

Comments from Dr. Daniel Stram

1) A main finding is that no EPA program has fully implemented the science implementation framework recommended by SAB in 2000. It is not clear from reading the document whether decision making practice before 2000 had been seriously flawed by failure to integrate science and/or whether improvements in current practice have been made recently. It would be useful if the review could comment on how serious the overall issue either was in the past or remains today. There is discussion of concerns about the existence or growth of "program silos" which I assume means bureaucratization. Unclear how widespread or significant this issue really is. Are there examples of poor or delayed decision making that resulted from such bureaucratization? Right now the report seems very general and almost devoid of "real examples" of problems or issues that have risen in the past or are continuing today.
Page 10: I don't know what it means that "pollutants cut across media lines" (explanation please)

Comments from Dr. John Vena

1. Were the charge questions adequately addressed? Yes

2. Are there are any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report? No

3. Is the draft report clear and logical? Yes

4. Yes