Has the project team adequately described and prioritized the high level quantitative science requirements that motivate and flow down to the overall infrastructure design?

- >15 years of community planning led to creation of the OOI Science Plan.
- To advance our understanding of ocean and Earth processes, and their interactions, we need:
  - A continuous, interactive presence in the oceans with high temporal resolution, especially to measure episodic events or dynamic systems with small scale components whose characteristics change over time periods longer than a few months.
  - Infrastructure enabling investigation at the time and length scale(s) of relevance to the science questions under study, including high vertical resolution from the sea surface to the sea floor.
  - Adaptive sampling, allowing targeted science campaigns in response to detected episodic events.
  - The payload capacity to field diverse, multidisciplinary sensing systems
- High Level OOI Requirements:
  - Interoperability
  - Expandability
  - Upgradeability
  - Life Cycle Cost Effectiveness
  - Occupy sites for 25 Years
  - Open Designs
  - User Support Services
  - Event Detection and Adaptive Sampling
- High Level GSOb Requirements:
  - Provide the technology to enable an international global network of open-ocean observatories to address global-scale science questions.
  - Provide two-way communication and near real-time data telemetry from sites in the open ocean; and, where required by the Science User Requirements (SUR), provide power to a seafloor junction box.
  - Establish and sustain cutting edge, high capability observatories at key sites that in synergy with other sampling methods advance the ocean sciences.
  - Develop new technology for occupying sites at high latitudes, especially in the Southern Ocean, where few observations are currently available.
  - Powered high-latitude mooring.
- DEOS Workshops identified areas of scientific interest and advances in research, which could be furthered by global observatory systems.
- RFA process used to identify installation locations for multidisciplinary and high priority science.
- D&I Workshop helped prioritize the installation locations, and instrument suites desired for each location.
- CND captured highest priority science within budget constraints.
- SUR shows the high level science requirements and the requirement flow-down from numerous reports and workshops.

Are OOI research objectives well linked to science user requirements? Are these user requirements met by the proposed network design?

- OOI research objectives are closely linked to the SURs.
  - OOI research objectives were derived from extensive community involvement
  - SURs were derived from OOI research objectives
• SURs also derived from DEOS and D&I Workshops, as well as RFA process.
• Individual SUR satisfaction will depend on final design and resultant fiscal constraints.

Is the description of infrastructure needed to meet OOI's science objectives adequate, including the system-level design and definition of functional requirements?

• Need for RCO, CSO, GSO observatories, and CI element are well-justified through community workshops, as well as NAS and NSF reports, as summarized in the OOI Science Plan.
• System-level design initiated with DEOS workshops, and iterated upon through RFA process and D&I Workshop.
• System-level design and functionality will continue to be refined.

Has an appropriate schedule for implementation been developed for each of the three scales of the OOI?

• The PEP (Appendix 4) explains the approach to the critical path. The funding profile and the need to fit the RCO into that profile controls the overall schedule. CSO and GSO implementations are fit in around the RCO.

Are cost estimates for infrastructure at each of the OOI scales well justified and do they encompass all aspects of implementation?

• Cost estimates are organized and reported by WBS.
• Budget contingency is managed by Program Office.
• Cost estimates include core instruments.
• Cost estimates were developed for each of the nine high-priority global sites, a moveable Pioneer Array, and an acoustic source mooring off Hawaii. The estimates include costs for hard goods, labor, installation and annual maintenance.
  - Capital costs were estimated from hardware lists using published prices or industry cost analogies. Hardware includes buoys, buoy payloads, moorings, subsurface mooring hardware, etc.
  - Labor costs estimated from experience form similar systems using standard salary rates.
  - Installation costs are estimates from experience and include crew, mobilization/demobilization, global or intermediate class vessels depending on site location and activities.
  - Annual operations and maintenance costs include operations staff, shore facility support, telemetry charges, and spares.
• Cost estimate detail summarized in Excel tables.

Are there lingering elements of the OOI network that require further engineering development and has as a research and development plan been proposed that provides a roadmap to complete these efforts to ensure all elements of the system will be ready for deployment?

• The GSO uses many elements of well-understood buoy design.
• The GSO buoys will need to be designed to provide an optimum sampling platform for sensors from diverse disciplines, thus requiring attention to flow disturbance, shadowing, RF and engine exhaust contamination, and other issues.
- The GSO will employ novel engineering designs to enable high-latitude powered spar buoys.
  - This will involve engineering development
  - This will require consideration of deployment and recovery strategies
- The GSO IO will identify any specific R&D needs and provide a plan for appropriate development and testing.
- The GSO IO will also provide an engineering risk assessment of expected additional funds required should the technology schedule slip
- Sensor technology may require R&D to handle the long-term, in-situ measurements that the OOI will enable.
- Sensors will not delay the deployment of the OOI; the sensors will be deployed when they have necessary capability.
- R&D for sensors will be accomplished via a three-pronged approach:
  - In collaboration with sensor suppliers
  - By individual PI's
  - For core sensors, by the responsible IO as designated in interface agreements.
- Types of capabilities that sensors will require:
  - Reliability
  - Non-cascading failure modes
  - Low power consumption
  - Ability to hold calibration or self-calibrate
  - Survivability in severe environments
  - Non-attended operation
  - Interfaces to Cyberinfrastructure
  - Resistance to or methods to mitigate bio-fouling
  - Ability to operate unattended for one year.
- An OOI-wide instrument qualification and acceptance process is envisioned.
- Enhanced mobile platform technologies, including AUV's, gliders, and drifters, may require additional R&D to provide a reliable docking system and appropriate endurance. The OOI infrastructure is being designed to provide power and data services to such docking systems should they be developed, however docking systems will not delay deployment of the OOI.
- There is a strong community desire for a standardized instrument interface across platforms. R&D efforts are likely required to facilitate development of a standard instrument interface. OOI will leverage the experiences of the MBARI “smart network” sensor puck, NEPTUNE SIIM, and ROADNet project during the interface definition process.

**Are the project staffing levels for each Implementing Organization (IO) adequate to complete the tasks required to complete the network designs and implement them?** (This information will be preliminary as the proposals for the GSO IO will not have been received.)

- Preliminary information on IO management is in the Project Execution Plan, section 3.5; pg. 14.