GSO Framework for Global Research Infrastructures and How NEON Aligns

Core purpose of Global Research Infrastructures.

Global Research Infrastructures should address the most pressing global research challenges, i.e. those frontiers of knowledge where a global-critical-mass effort to achieve progress is required. Science, technology, innovation, and advanced research training goals should be fully integrated throughout the infrastructure plans from their early development.

Actively engaged in a broad effort to 'harmonize' or 'make interoperable' numerous environmental observatories and networks, that include EU ANAEE, EU ICOS, EU eLTER, EU IAGOS, GEO, South Africa SAEON, China CERN, iITER, and others. This includes; science, user/ stakeholder communities, data, informatics, technology, innovation, economic relevancy, and others.

Defining project partnerships for effective management.

Global Research Infrastructures initiatives should explicitly and clearly define, as early as possible, the roles and responsibilities of the partners through the different phases of a project's full lifecycle: planning, construction, operation, upgrading, and termination or decommissioning. Rules for future participation should be defined to allow the inclusion of new partners.

NEON contracted expertise in the 'business readiness' review (preliminary review) so that all our business and project management activities were state of the art and commensurate with what NSF needed (at that time in development).

Defining scope, schedule, and cost.

Stakeholders should agree upon a shared understanding of the foreseen scope, schedule (including a timetable) and cost, addressing inherent uncertainties and any external constraints, and define processes to effectively address deviations.

New Infrastructure often requires the ability to conduct 'transformative sciece', which also means science the 'has never been done before'. Hence, scope is new, techniques to realize scope is new, and the pressures to expand scope contintued throughout NEON's project developement phases. Scope management from inception through commissioning was very important in the development phases of NEON (and difficult). System engineerRobust costing; levels of estimates (LOE); risk registries, management and mitigation; work breakdown structures; change control process, document control process; and baselining and re-baselining is still a common occurrence. Experienced and dedicated staff is required to preform these efforts. (has to be a resourced activity).

Project management.

Appropriate management structures and professional top level management should be established, consistent with best practices derived from existing recommendations and experience at the international level, to ensure rigorous project management.

Rigorous project management controls, reporting nad metircs establishes early in NEON's project history. The use of protypes were essential to mitigate adn reduce risk between the design adn implementation phases. At the scale of NEON's investment and complexity, It was imporatnt to track weekly metirics. Several instances of non-linear behavoir were identified and mitigated.

Funding management.

The development of a Global Research Infrastructure should foresee a careful balance between the minimum acceptable percentage of in-cash contributions and the appropriate level of in-kind contributions. The in-kind contributions have to be effectively evaluated regarding quality and schedule.

Not really applicable for NEON. However, the issue of tying resources to more than one funding source places the whole project at risk.

Periodic reviews.

The scientific output and strategic goals of Global Research Infrastructures should be periodically evaluated and updated if needed throughout the entire lifecycle to ensure consistent excellence of the scientific output. In addition, an assessment of the quality of the services offered to the scientific communities is necessary to ensure the long-term usefulness and success of the infrastructure. Partnership agreements among funding agencies must enable each nation to fulfil its unique stewardship responsibilities on behalf of its national government for oversight of contributed funds.

There seems to be very tractable phases in large research infrastructure project development that requires conceptual (design), preliminary (business readiness/ preparatory) phases, construction and commissioning,and operations (business model). NEON followed the NSF's review and no / no go review/merit structure. Which were very constructive in addition to the necessity of passing a milestone. What was unclear, is how many sub-system reviews would be needed leading to the preliminary design review. These sub-system reviews not only prepared the whole project for more larger and formal reviews, but also built the skillsets and experience in scientists and other project managers. NEON conducted 16 formal NSF reviews in an 18 month period during the preliminary design phase.

Termination or decommissioning.

Planning for termination or decommissioning of a Global Research Infrastructure initiative should be established early in the development of the facility where possible or relevant, by defining criteria for the conclusion of operation, and establishing exit criteria and procedures for closing down and recognizing future termination liabilities or encumbrances on the sponsors at the conclusion of operation.

NEON only addressed this in the context of what is required of land use agreements.

Access goal based on merit review.

The GRI policies should reflect the global-Excellence-driven Access (gEA) paradigm through publication of a clear and transparent access goal. The goal should incorporate a peerreviewed process that recommends access based on the most promising emergent ideas, regardless of the country of origin or the ability of the proposer to contribute financially.

Focused test of latest Framework Criteria: NEON was considered an exemplar in the final design review that led to the approval of construction funds. In addition to System Engineering, Business systems, and formal project management, many other aspects of the project were required and led to better overall project management. For example, health and safety, concepts of operations model, project execution plan, quality control (science and programmatic), technical and advisory boards, traceability flowdown from high level grand challenges to data products, education and engagement, etc.. A fully resourced, loaded, and linked budget (down to individual price quotes) were considered state of the art. We did not explicitly include economic relevancy or innovation at this stage of review.

Digital Infrastructure.

Global Research Infrastructures should develop and operate under appropriate, state-of-the-art Data Management Policies (DMP). These policies should consider: (1) data quality verification; (2) data curation; (3) compilation of metadata; (4) data exploitation including remote (interactive) access through the global digital infrastructures to enable scientific research; and (5) providing data services compliant with generally agreed formats and rules such as those from the Research Data Alliance (RDA) and other international or community-driven data access agreements.

NEON conscribes to all these activities, DMP, data curation, adopt international (ISO) metadata standards, data cess and data portals, data analytics and tools, and we are a formal and active Corporate member of RDA. NEON is separately funded (NSF SAVI) to lead the 'harmonization' and 'interoperabilty' of e-infrastructures--that include (from the US) Carbon and Biodiversity 9NEON), sesmology and geodesy (UNAVCO and IRIS), space weather (AMISR), and Blue water Oceans (OOI). Road mapping and strategic plan was developed and currently implented (in part) under the project name COOPEUS. This effort also includes that ability to lower the barrier for entry of users/stakeholders to utilixe infrastructure 'Big Data'.

Data exchange.

Global Research Infrastructures and users should recognise the importance of data exchange and interoperability of data across disciplines and national boundaries as a means to broadening the scientific exploitation of individual data sets, promoting new scientific approaches and collaborations, as well as promoting innovation. To that end, the DMP developed by GRI, and agreed to by the users, should be in alignment with the goals of openness of high quality scientific data (i.e. Findable, Accessible, Interoperable, Re-usable; FAIR) and reproducibility principles, as well as abiding to relevant intellectual property rules and laws.

NEON goes beyond the FAIR data principles. FAIR only aspires to the interoperabily of data itself, not for the utility of the data to advance science. In addition to the FAIR principles, their are other characteristics of the data that require interoperability--particularly in light of the need to develop a forecasting capability. Other characteristics include (i) survey of requirements, mission statements, hypotheses, (ii) traceability to known standards, best community practices, first principles with estimated uncertainties, and (ii) algorithmic processes that derived the data products with the estimated uncertainties.

Clustering of Research Infrastructures.

Where clustering of complementary Research Infrastructures appears to be consistent with the mission of the Global Research Infrastructure, schemes for access and mobility of researchers, engineers and technicians through the cluster should be actively encouraged.

Besides what is noted under e-insfrastructures). Other networks are important structures for engagement and advancing the science frontier, such as (in NEON's case), LTER, iLTER, CZO, iCZO, and other agency activities, such as NOAA US Climate Reference Network (CRN), USDA Agricultural Research Service (ARS), DOE Atmospheric Radiation Measurement (ARM) and AmeriFlux Networks, Important to note, that Environmental Research Infrastructures provide a unique type of data to enable the advancement the frontiers of science and knowledge, but used in conjunction with other networks, brings different types of data together, such as large coordinated experimentation, individual PI-based research, and other Long Term Observational Networks.

International mobility.

Measures to facilitate the international mobility of scientists and engineers to participate in Global Research Infrastructures should be promoted.

NEON does not have a similar program as the EU to support researchers at different infrastructures outside Europe, i.e., TransNational Access (TNA). However, NEON recognizes the importance of international mobility and international engagement with the researcher community, because the scientists self-organize in this way. So (in addition to the COOPEUS project and e-infrastructures, and data exchange), NEON has fostered international engagement through:

- Visiting scientists, visiting Project Managers
- Regular Joint workshops with EU Infrastructures
- Regular Joint symposia, papers and booths at Society conventions (e.g., EGU, AGU)
- Active participants in EU projects designed to foster synergies among infrastructures (ENVRI+, COOP+)
- Active participants in international networks (iLTER, ICZO, CERN, TERN, SAEON, KEON, INTERACT, MexFlux, etc.)
- Active Participant in global meetings/plans to federate Global Environmental Observatories (Australia, China, Austria, GEO).
- Use of MOUs to foster exchange.

Innovation, technology transfer and intellectual property

Global Research Infrastructures should develop an Innovation Promotion Plan (IPP) with clear goals and strategies for the promotion of innovation and technology transfer and the management of intellectual property. The plan should also describe how the GRI will monitor and assess the socio-economic impact of innovation and technology transfer. These plans should recognise the differing opportunities for innovation at each stage of the RI lifecycle as well as the barriers and drivers appropriate to the particular GRI context.

NEON has focused its attention solely on the design, construction and operations of the observatory. In part because its design was based on OTS technologies. Once (now) in operations, the need to capture and innovate designs and products are more of an interest. Functional processes (trainings) are in place to capture IP and IPR and other ancillary business opportunities. We are also currently recognizing the economic relevancy and innovation potential of the NEON deliverables (data products) and technologies. We make a distinction between upstream innovation (technologies with limited economic return) and downstream innovation (value added data products which have proven to generate new economies).

Monitoring socio-economic impact.

The socio-economic impact and knowledge transfer issues of Global Research Infrastructures should be assessed not only in the beginning but during the lifecycle of the project. The GSO will refer also to the OECD Global Science Forum work on the socio-economic impact of Research Infrastructure.

N/A

National Ecological Observatory Network