PROGRAM STRUCTURE AND GOVERNANCE

Moving SZ4D forward, together

To achieve SZ4D's ambitious goals requires management and governance structures capable of:

1. Efficiently and effectively supporting significant **infrastructure**, including instruments deployed in the field and in laboratories, open access to near-real-time data, a Modeling Collaboratory and other new SZ4D consortia, and deployment of scientists to make critical, systematic measurements
2. Enabling and inspiring **innovative research** supported by proposal-driven funding, including seed funding
3. Coordinating across the SZ4D disciplines, focus sites, and crosscutting themes; coordinating with funding agencies; implementing a collective impacts model across all communities to ensure maximum societal impact; evolving the SZ4D program as needs change and unforeseen discoveries and circumstances arise; communicating back and forth with international, operational, and stakeholder partners; and executing community governance.

The proposed model for these management and governance structures would provide guidance to and independent oversight of three major SZ4D components:

1. A **Center** that manages and coordinates SZ4D Facilities,
2. Five **Facilities** that provide support for instrument development, acquisition, deployment, and data management, and
3. A **Science Program** at NSF whose mandate would be to identify the most promising SZ4D-centered research projects through a merit review process.

SZ4D CENTER AND GOVERNANCE

To ensure successful execution of the SZ4D initiative, a governance structure will be established to guide program evolution, evaluate progress, coordinate all involved communities, ensure information transfer, and foster partnerships for SZ4D. Oversight bodies and the envisioned management structure will coordinate the program at all levels, enabling the community to build the required SZ4D intellectual infrastructure and to create a program that is greater than the sum of its parts.

A proposed transitional governance structure designed to meet current SZ4D needs has been developed and implemented based on community and facility feedback (**Figure SG-1**). This initial structure is simple, consisting of a Steering and Executive Committees that oversee the work of the SZ4D Center. These two committees are guided by input from three working groups and two integrative groups plus two planning committees. In the transitional structure, committee members play more than one role (e.g., Executive Committee members also serve on the Steering Committee, working and integrative group chairs also serve on Steering Committee). Below we describe in more detail the transitional committee structure charges.

Governance

Committee on Committees (CoC)

The CoC develops slates of candidates for the committees (orange) and the working and integrative groups (green) defined in **Figure SG-1**. It combines nominations from each committee, volunteers from the community, and scientists identified by the CoC's own deliberations to ensure diversity balance by discipline, institution, and demographics. Committees, as well as working and integrative groups, can include both domestic and international members. The CoC recommends slates of candidates for each of the committees and working and integrative groups to the Center Steering Committee, as well as co-chairs for each committee and group. Three-year terms will be staggered such that each year the CoC will recommend a slate with a target of two-thirds current members and one-third new members. The CoC targets ranges in membership numbers (described below), but is empowered to adjust as necessary to maximize participation in SZ4D. Target size is 5-10 members.

Center Steering Committee (SC)

The SC coordinates and oversees all SZ4D activities. The SC is also charged with overseeing the general operations of SZ4D, including ensuring a suitable meeting calendar, effectively using the budget to forward SZ4D goals, and resolving competing objectives between the Collective Impact Advisory committee and the working groups. Major strategic decisions will be brought to and made by the SC. All proposals committing SZ4D staff and facilities must be approved by the SC.

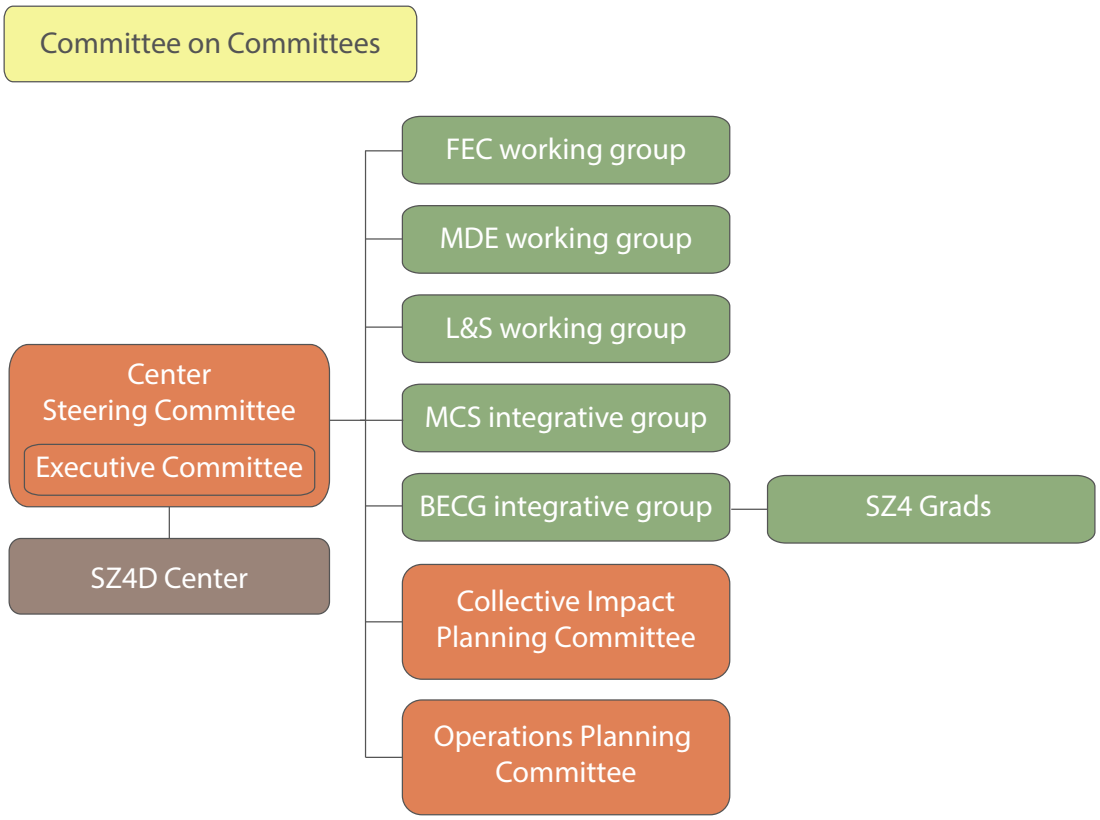

Figure SG-1. *Organizational diagram showing the SZ4D Transitional Committee Structure. The transitional structure retains the working and integrative Groups (green boxes), while adding a Collective Impact and Operations Planning Committee. All of these entities inform the Center Steering Committee that oversees the SZ4D Center. The Committee on Committees is an independent entity tasked with populating the membership of the committees and working and integrative groups.*

The current SC approves committee and working and integrative group nominations provided by the CoC. The SC assigns liaisons to all other committees from the SC membership. The target size of the SC is 15-20 members. The SC Chair is responsible for running SC meetings, serving as a point of contact for external partners and agencies, organizing and facilitating agenda-setting for SZ4D, and chairing the Executive Committee.

Executive Committee (ExCom)

A subcommittee of SC serves as the ExCom, which meets more frequently than the SC and curates information for SC decisions. The ExCom is charged with developing and coordinating strategies, responding to funding opportunities, and pursuing potential partnerships. ExCom and its members may also serve as points of contact with agencies and international partners as needed. During the transition period, the ExCom will initially retain its current membership and will institute staggered terms of three years to refresh its membership as SZ4D grows. The PIs of the SZ4D Catalyst proposal retain ex officio roles as long as Center activities are covered under that grant. Future Center PIs would assume the same ex officio roles. The target size of the ExCom would be six members.

Collective Impact Advisory Committee (CIC)

The CIC supports scientific priorities and broader impacts by monitoring SZ4D scientific and capacity building activities and advising the SC

on ways to better meet SZ4D's Collective Impact goals, such as redistributing resources. The CIC is composed of representatives from each of the active members of disciplinary communities, Integrative Groups, and Facility committees. Expertise in science relevance to agencies beyond NSF are included in this committee (e.g., NASA, USGS, NOAA). Co-chairs of the CIC will regularly report to the SC. The target size of CIC is 15-20 members.

Operations Planning Committee (OPC)

The OPC oversees SZ4D operational needs. Initially, the OPC is charged with providing scientific guidance for the design of five facilities that would support:

1. Offshore instrumentation,
2. Onshore instrumentation,
3. Field programs that require human deployment,
4. A modeling collaboratory, and
5. Experiments and sample archiving.

The OPC will work to develop the necessary proposals to support the new infrastructure. As the SZ4D Facilities are created and become operational, it is expected that the OPC will create separate oversight committees for each of them. Target membership is 15-20, with a balance of expertise relevant to the five envisioned future facilities. Expertise in data management may also be critical to the work of this committee. Members will have staggered three-year terms.

Working Groups and Integrative Groups

During the transition period, the working groups (FEC, L&S, MDE) and integrative groups (BECG, MCS) will maintain activity with refreshed memberships. These groups are viewed as representative of the community and should consult regularly with members of the community to assure alignment between community needs and SZ4D actions. The target size for each working and integrative group is 15-20 members.

Additional ad hoc subcommittees of specialized expertise may be convened by any committee as necessary as SZ4D moves to a fully built configuration. Once funding for a particular activity is secured, the SC should discuss appropriate ex officio roles for the activity's PI.

Management

The **Executive Director** of the SZ4D Center will be directly accountable to the Center Steering Committee. This structure distances the management and execution of the specified scientific directions and priorities from the governance that defines them. The SZ4D Center's full-time, professional staff will provide continuity, accountability, points-of-contact, direction, and management for the program.

We also anticipate that data needs may emerge that are not defined at the outset of the new SZ4D facilities and are described below. Additionally, a nimble, event-based rapid response capability may be required to capture the phenomena we wish to understand as part of SZ4D. Because there are many potential responses and data types, we have designed a Critical Data Collection mechanism to direct resources to the appropriate facilities and entities in the event that novel data must be collected rapidly, or activities must be performed to guarantee that all of the pieces of the SZ4D project fit together properly. This Critical Data Collection mechanism will be overseen, and actions approved, directly

by the Center Steering Committee. These scientific needs will be communicated to the Executive Director, who will then determine the appropriate facilities and entities to task with Critical Data Collection. This mechanism is intended to enable the identification and collection of emergent data needs that require flexible allocation of resources to combinations of facilities and entities, while guarding against a Center-based ad hoc science funding program.

INFRASTRUCTURE AND FACILITIES

SZ4D will require both new facilities and partnerships with existing facilities. A combination of new and existing facilities will support instrument development (e.g., seafloor), establishment of instrument networks (e.g., volcano sensor arrays), field deployments of instruments on land and at sea, and data collection that requires people as the primary observational instruments (e.g., paleoseismology and volcano chronology). New consortia are envisioned, such as the Modeling Collaboratory for Subduction and the Laboratory and Sample Consortium, to meet SZ4D objectives. The specific facilities that are essential for supporting SZ4D research include:

- Newly designed **offshore** seismic, geodetic and other instrumentation, instrument pools, mobilization teams, and marine vessels (crewed and autonomous) for deployment, service, and rapid response near the site(s) of dense deployment. The US solid Earth community has not previously attempted an offshore subduction zone observatory of this scope and duration. This seafloor facility must have the capability to respond rapidly (hours to days) to both problems and opportunities and hence implies dedicated personnel and seagoing resources.
- Newly designed **on-land arrays**, including volcano arrays with satellite telemetry for transmitting data in near-real time; environmental observing networks for landscape and deformation sensing; deployable arrays for rapid response in regions with little prior infrastructure.
- Support (e.g., for logistics, sampling instrumentation, and analyses) for field programs that involve **deployment of humans** as the primary observational instruments to collect systematic, standardized, critical data inclding paleoseismology, framework mapping, sampling and analysis for geochronology, geochemistry, petrology. This could also involve opportunities for student training, graduate and postdoc support, capacity building, and REU programs.
- **Modeling Collaboratory for Subduction** to develop new physics-based models and data-driven computation for subduction zones and to provide resources for their use by the whole SZ4D research community including students, postdocs, researchers.
- **Laboratory and Sample Consortium** for the study of material properties and rheology during deformation and phase equilibria of molten systems, including analog modeling and infrastructure for archiving samples collected as part of the SZ4D effort.

Management of the new facilities would ultimately fall under the SZ4D Center to ensure coherent data collection and coordination throughout the duration of SZ4D (**Figure SG-2**).

However, each of these facilities needs ready access to scientific expertise and a granular level of oversight of each's activities. Thus, each facility component is expected to be associated with its own advisory committee, whose membership would be determined through the Committee on Committees process, and whose members would serve fixed terms. These advisory committees would report to the Science Advisory Committee (**Figure SG-2**). The rotating composition of the Facilities' Advisory Committees would allow broad participation in the scientific oversight process, while providing continuity to the direction of the facilities. As described above, the scientific activities of the facilities would be coordinated through representative membership on the Center Steering Committee to maximize scientific impact and efficiency throughout the lifetime of the SZ4D project.

In addition to these new facilities, it may be beneficial to expand the capabilities of existing facilities and consortia, leveraging their expertise to support the collection and distribution of new and novel instrument networks and datasets. For many objectives, SZ4D is anticipated to partner with existing or forthcoming facilities or organizations, such as managing seismic and geodetic data with the Earthscope Consortium, acquiring high resolution elevation data from Open Topography, or collecting geochronologic data with the National Consortium for Geochronology. Additionally, many organizations successfully manage field deployment of on-land seismic and geodetic instruments, including the EarthScope Consortium (ESCO, successor to IRIS/UNAVCO) and the USGS Earthquake Hazards Program. Organizations specializing in geophysical data archiving and real-time access to data are NASA-JPL, IRIS/UNAVCO, and the USGS Earthquake Data Centers and Volcano Observatories. For experimental petrology, geochemistry, and structural data archiving and access, Library of Experimental Phase Relations (LEPR), ENabling Knowledge Integration (ENKI), GEOchemistry of the Rocks of the Ocean and Continents (GEOROC), Interdisciplinary Earth Data Alliance (IEDA), PetDB, and Strabospot are excellent examples of existing database efforts. The National Consortium for Geochronology is a natural partner for the acquisition and archiving of geochronology data. High-resolution topography and bathymetry data are acquired, archived, and shared through the National Center for Airborne Laser Mapping (NCALM), 3D Elevation Program (3DEP), OpenTopography, Marine Geoscience Data System, and IEDA. The Ocean Bottom Seismic Instrument Center (OBSIC) group will be essential in coordinating the design and implementation of ocean bottom seismometer components, as will other marine operators such as the University-National Oceanographic Laboratory System (UNOLS) and the International Ocean Drilling Program (IODP). It will be imperative to partner with international organizations for major field deployments (e.g., within Chile, as an example, Southern Andes Volcano Observatory [OVDAS], SERvicio GEOlógico MINero [SERGEOMIN], and many universities). Curation of physical samples and experiments will be necessary for coordinated efforts, and CONVERSE, the Smithsonian Institution, and IEDA are already developing new models. Existing centers such as Computational Infrastructure for Geodynamics (CIG), Community Surface Dynamics Modeling System (CSDMS), and the Southern California Earthquake Center (SCEC) are valuable partners for code development, training and hosting thematic workshops. To maximize the impact of SZ4D in hazard mitigation, partnerships with

the World Volcano Observatories (WOVO), the USGS Hazards program, Volcano Disaster Assistance Program (VDAP), Global Earthquake Model (GEMS), and the National Oceanic and Atmospheric Administration (NOAA) tsunami early warning centers will be vital.

Figure SG-2 displays the fully constructed SZ4D organizational structure,including the core committee, more detailed facility oversight committees, and central elements of the SZ4D Center. The diagram also illustrates connections to funding agencies that would enable a SZ4D Science Program.

SZ4D SCIENCE PROGRAM

A critical part of the success of SZ4D is support for proposal-driven research, as it invites innovation and exploration of new techniques and approaches and provides an access point that is open to the widest PI community. All proposal-driven research would address SZ4D Building Equity and Capacity with Geoscience goals (see **Chapter 3.1**), thereby ensuring maximum impact of SZ4D science on society. Proposal-driven research needs could be met by convening an SZ4D Science Panel at NSF and other agencies. The panel would be guided by peer review, consistent with agency practice and independent of SZ4D governance. The panel scope could be directed with open RFPs that focus on certain science problems, focus areas, or integration activities at different points along the SZ4D timeline, as guided by the SZ4D Center. Proposals could range from multi-PI, multidisciplinary projects to single-PI projects. A dedicated SZ4D Seed Funding program could serve as an on-ramp to SZ4D, especially for early career scientists. Another mechanism for entraining and retaining early career scientists would be supporting SZ4D graduate fellowships, postdocs, and CAREER-type grants.

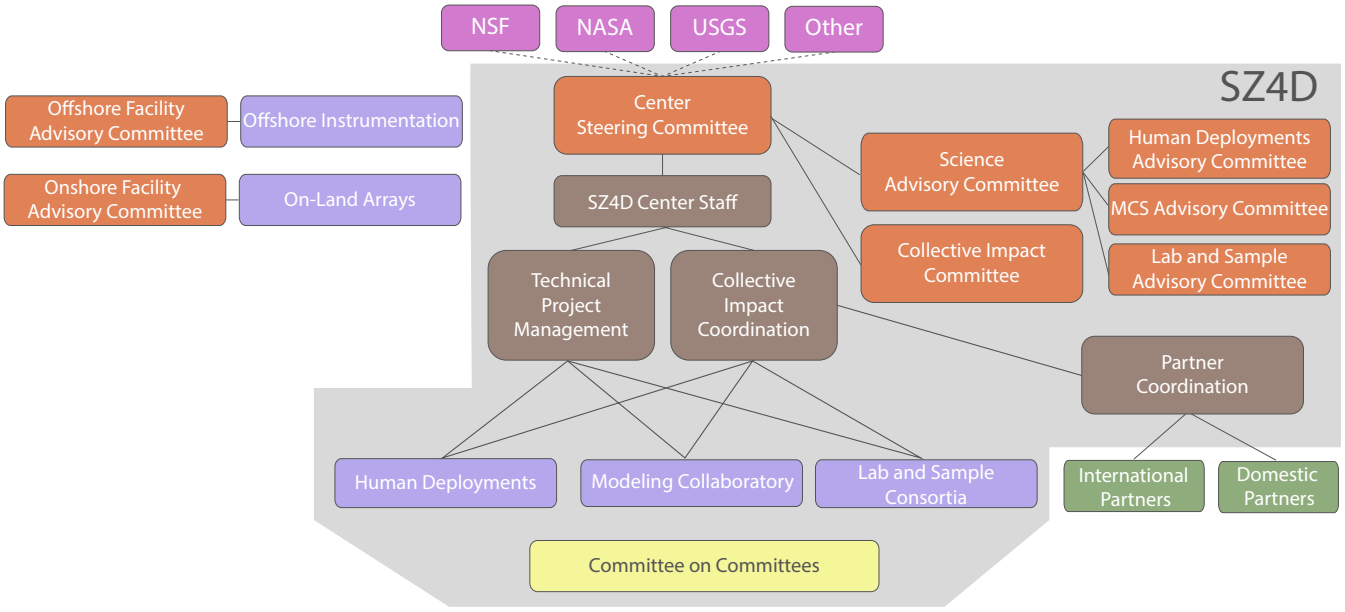

Figure SG-2. *Organizational structure of the fully constructed SZ4D Center (brown); Advisory Committees (orange); Facilities (purple); International and Domestic Partners (green); funding agencies (pink); Committee on Committees (yellow). Gray marks the extent of the SZ4D community.*