Belmont Forum E-Infrastructure and Data Management

Phase 2: Implementation Plan

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Contents

Proposed Implementation Plan is based on recommendations described in the Community Strategy and Implementation Plan released June 2015. Many thanks to the Steering Committee members who contributed their input and expertise.

Statement of Purpose

The Belmont Forum (BF) Implementation Plan for the e-Infrastructure and Data Management Collaborative Research Action (E-I&DM CRA) describes the coordination of four interrelated programs that leverage existing knowledge and resources to illuminate achievable, reproducible systems for effective, sustainable data management practices. This effort will help achieve the Belmont Forum's stated goal "to deliver knowledge needed for action to avoid and adapt to detrimental environmental change including extreme hazardous events."

In June, 2015, a Community Strategy and Implementation Plan (CSIP) was released as the final report of a two-year scoping phase. Recommendations developed in the report describe a path toward integrating large amounts of diverse data across scientific disciplines to deliver policy-relevant, decision-focused knowledge that decision makers require to respond and adapt to global environmental change and extreme hazards, manage natural resources responsibly, grow our economies, and limit or even escape poverty.

The five recommendations are:

1. Adopt Data Principles that establish a global, interoperable e-infrastructure with cost-effective solutions to widen access to data and ensure its proper management and long-term preservation. Researchers should be aware of, and plan for, the costs of data intensive research.
2. Foster communication, collaboration and coordination between the wider research community and the Belmont Forum, and across Belmont Forum projects through a Data and e-Infrastructure Coordination Office established within a Belmont Forum Secretariat.
3. Promote effective data planning and stewardship in all Belmont Forum agency-funded research to enable harmonization of the e-infrastructure data layer through enhanced project data planning, monitoring, review and sharing.
4. Determine international and community best practice to inform Belmont Forum research e-infrastructure policy, in harmony with evolving research practices and technologies and their interactions, through identification and analysis of cross-disciplinary research case studies.
5. Support the development of a cross-disciplinary training curriculum to expand human capacity in technology and data-intensive analysis methods for global change research, and increase the number of scientists with cross-cutting skills and experience in best practice.

The Belmont Forum adopted a data policy based on the data principles described in the report at the Plenary Meeting in Oslo, Norway in October, 2015. The remaining four recommendations are being developed as internationally-coordinated Action Themes. Each Action Theme group will work to accomplish its own set of objectives: Development of a Coordination Office (Action Theme 1); Data Planning (Action Theme 2); e-Infrastructure (Action Theme 3, delivered through scoping workshops); and Human Dimensions (Action Theme 4, focusing on development of

training materials, curriculum, et cetera). Completion of the CSIP's stated objectives is dependent upon tightly choreographing activities throughout Action Themes. A priority of this approach is to coordinate the objectives of these Action Themes with resources and ongoing Belmont Forum funded projects. Because activities and findings from one Action Theme will heavily influence activities in other Themes, this organizational structure requires a top down collaborative approach, described in detail below.

E-I&DM Proposed Organizational Structure

The 2013-2015 E-I&DM CRA Secretariat was organized by the funding provided by two BF member agencies, the U.S. National Science Foundation (NSF) and the U.K.National Environment Research Council (NERC), with a Steering Committee engaging experts from all participating agencies. In the Implementation Phase, more Belmont Forum member organizations have offered help with leadership and organization of specific Action Themes, so the new organizational structure needs to reflect these changes. However, the structure also needs to preserve the openness and inclusivity which has been the hallmark of this CRA to date, and the work must remain congruent with that of other international initiatives, such as the Group on Earth Observations (GEO) and Future Earth (FE), and organizations such as the (RDA). In the implementation phase of this CRA, the Steering Committee will be constructed as a Science Advisory Board (SAB) with a corresponding shift in responsibility, and will provide guidance to the Action Theme groups on a regular basis.

Science Advisory Board

It is proposed that SAB Belmont Forum agencies participating in any Action Theme will appoint a representative to the Science Advisory Board (one representative per member agency), with the possible addition of non-voting representatives or observers from appropriate international bodies, such as GEO, to be nominated by those bodies themselves. There is the continuing need to work closely with the Group of Program Coordinators (GPC) from the Belmont Forum agencies to ensure good governance and conformance with Belmont Forum principles and practices.

The objective of the SAB is to provide advice and peer review from the entire Belmont Forum members' perspective on the scientific, social, and technical aspects of the EI&DM CRAs. The SAB will review scientific drivers and priorities, provide scientific and technical guidance and advice, and perform special assignments as requested by the GPC or the Secretariat Coordinating Group (SGC, defined below).

The SAB is expected to meet on a monthly to bimonthly basis with approximately 8-10 meetings each year. Meetings may occur as needed, called by the GPC, or requested by the SCG.

SAB duties include:
- Providing advice, in cooperation with agencies concerned, on how participant organizations can work together more effectively, avoid mission creep and overlap, and curb counter-productive competition
- Offering recommendations to the SCG on priorities related to science/tech/CI that should be supported or encouraged within the project
- Identifying knowledge gaps that are being or could be addressed outside the BF framework so BF can strategically direct its limited resources
- Identifying specific assessment needs that could be addressed by ongoing assessments or new assessment activities
- Advising on issues related to data-intensive science and transdisciplinary data needs and use in global change research
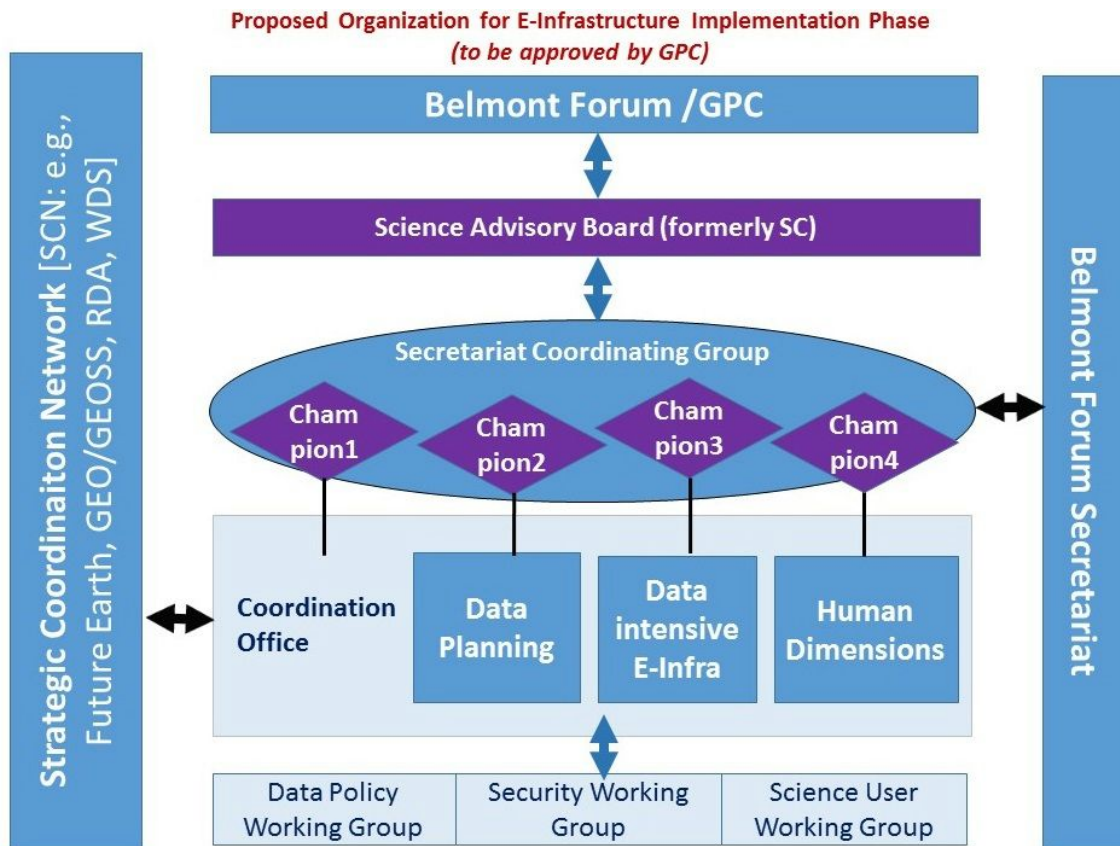

Figure 1: Diagram of proposed Implementation Phase organizational structure

Action Themes

Each Action Theme will be funded and supported by self-forming groups of participating Belmont Forum members independent of other actions. Participating countries each choose which Action Theme(s) to participate in and the type and amount of resources they can contribute.

Action Theme groups will develop and manage their own activities, recommendations, and deliverables on an individual basis, yet commit to work in coordination with the other Action Themes. Action Theme deliverables shall be coordinated to integrate with activities of other Action Themes through the SCG, with oversight from the SAB and GPC and administrative assistance from the Coordination Office. (Administrative support includes management of a master timeline, organization of virtual meetings, maintaining the Knowledge Hub, and coordinating communication and collaboration of activities among the Action Themes.)

Each Action Theme group will identify a Champion, with expectations of agency support of at least 0.25 FTE (Full Time Equivalent or one person working full time). The Champion will be an intellectual leader, chosen and supported by the corresponding Action Theme lead and co-lead agency. Each Champion will represent their Action Theme in regular meetings with the other Action Theme Champions.

For Action Themes 1 and 2, a need has been identified for the positions of Coordination Officer and Data Information Officer. More information on these positions is available in the Action Theme descriptions.

Each Action Theme lead or co-lead agency is expected to provide support for activities within that Action Theme. Support could include:

- Funding scientists to work on the Action Theme, and providing in-kind donations, including personnel and facilities
- Agency staff participation in Action Theme planning and activities
- Organizing and hosting meetings and workshops

Leads and co-leads have a role in determining the governance of the initiative, including through: support of a Champion on the SCG; representation on the GPC and the Science Advisory Board; and by identifying and recruiting participants in the Strategic Coordination Network.

Secretariat Coordinating Group

A Secretariat Coordinating Group (SCG), comprised of Champions from all Action Themes and a representative from the Belmont Forum Secretariat, will act as a coordinating committee for

the initiative's activities and milestones. Champions will provide outreach and communication regarding the activities, goals and needs of their Action Theme to the SCG and to the wider community, as necessary. Due to their role in the SCG and their work within an Action Theme, Champions will not need to participate in additional boards.

As a body, the SCG will communicate with the SAB and the GPC about needs, goals and activities of each Action Theme group, and interact with the Strategic Coordination Network.

The SCG will meet virtually on a regular basis (expected to be twice a month) and additionally as needed. Schedule will be organized by the Coordination Officer, with the assistance of the Coordination Office. Tasks set by the SCG will be executed via the Action Themes with support and assistance from the Coordination Office.

Networks and Working Groups

The Community Strategy and Implementation Plan (CSIP) authors recommended the formation of both a Strategic Coordination Network (SCN) and two Working Groups, one on Data Planning (DPWG) and one on Security (SecWG), to be drawn from the wider scientific, legal and social science communities. The need has emerged for a third working group, comprised of e-infrastructure users in Belmont Forum projects (UsersWG).

Strategic Coordination Network

The Strategic Coordination Network (SCN) will serve as a conduit to national, regional, and global developments, trends, needs and opportunities in e-infrastructure and data management. The SCN will be comprised of any party interested in scientific data management and representatives from key groups involved in science e-infrastructure and data management (*e.g.*, GEO, RDA, World Data System (WDS)).

The SCN is envisioned as an inclusive body with a low bar for membership. Current goals are to establish a communications loop. Membership in the SCN will carry no obligations at this time other than a desire and willingness to communicate. The Coordination Office, led by the Coordination Officer, will be responsible for relaying communications regarding developments in the Action Themes to the SCN. The Knowledge Hub is intended to provide a variety of conduits to support these goals and activities.

Working Groups

The Data Policy Working Group (DPWG) and Security Working Group (SecWG) will advise the Data Information Officer, Coordination Officer and the SCG on issues of cyber-security and data policy.

To meet the Belmont Forum's goals of leveraging existing resources, it is proposed that Instead of convening and maintaining these groups for this project, the Coordination Office, under the oversight of the Data Information Officer, will research currently existing groups already addressing these issues, and network among groups if multiple groups sharing the purposes of data policy and data security exist. Output from these groups will be synthesized and disseminated among the Action Themes via the SCG. A formal collaboration may be sought with one or more working groups after research has been presented to and decided on by the SAB, GPC, and SCG.

The Science Users Working Group is intended to provide "ground truth" to the development of an e-infrastructure that actually meets the needs and requirements of the scientists carrying out the global change research funded through the Belmont Forum. The composition of the UsersWG should be drawn from participants in the BF funding calls and projects currently underway, in order to hear from users in diverse domains, addressing a range of scientific challenges. The SCG will identify and recruit candidates for the UsersWG or consider establishing a subcommittee under the Science Advisory Board as an alternative.

E-I&DM Action Theme 1: Coordination Office

Expected Outcomes

Fostering communication, coordination and collaboration among the diverse scientific, data and computational communities is intended to create a more sustainable and cohesive international community of practice, and will better support data-intensive research funded by the Belmont Forum and others by more effectively reducing barriers to data sharing and interoperability and promulgating procedures, standards, workflows, and other elements critical to forming a functioning e-infrastructure.

1) Establish a Coordination Office (described in CSIP as "Communication, Collaboration and Coordination Office") which provides and supports communication, collaboration and coordination among Belmont Forum-funded activities, e-infrastructure organizations, projects and experts, to promote greater awareness of the wider landscape of activity, facilitate access to external resources, and foster cooperation among other projects;
2) Establish and facilitate a Strategic Coordination Network;
3) Identify activities globally that would aid in the implementation, monitoring, support and evaluation of interoperability capabilities at the data and system level among Belmont Forum funded projects and participants;
4) Reduce or avoid duplication of efforts; and

5) Map the data and e-infrastructure "landscape" of activities, products, services, and organizations.

Scope and Partners

The scope of this Action Theme, as described in the CSIP, calls for the Belmont Forum to establish a data and e-Infrastructure Communication, Collaboration and Coordination Office (Coordination Office) to: foster communication, collaboration and coordination across Belmont Forum funded projects; engage with the wider global e-infrastructure community, including communication with global data and e-infrastructure activities; coordinate and support Theme actions and the Belmont Forum Secretariat; and establish a Strategic Coordination Network of e-infrastructure stakeholders.

The Action Theme proposes the following activities at an early stage:

- Establish a virtual Coordination Office to foster ongoing communication, collaboration and coordination
- Retain a Coordination Officer by contract to direct the Coordination Office, manage tasks, oversee office staff, and develop and execute a comprehensive outreach and communications plan. The Coordination Officer will report to the SCG, GPC and SAB and work with the Data Information Officer and leads of other Action Themes.
- Identify an Action Theme Champion as part of the SCG
- Assess and respond to administrative and logistical needs of other Action Themes, including:
    - Scheduling meetings and providing virtual meeting space
    - Maintaining materials, databases, and communication resources on the Knowledge Hub
    - Tracking activities and scheduling against a shared timeli
- Organize and engage a Strategic Coordination Network (SCN) comprised of representatives from national, regional, and global organizations, projects, agencies, and external to the Belmont Forum, that are engaged in any aspect of e-infrastructure and data management in order to identify and leverage best practices for use in Belmont Forum activities
- Establish, maintain, and grow a "map of the landscape" to identify and and foster collaboration and coordination among global e-infrastructure activities to aid in providing services to Belmont Forum activities
- Coordinate and support outreach activities among Action Themes

 The agencies that have expressed their willingness to lead this Action Theme are:

- NSF (USA) lead

- JST (Japan) co- lead
- MOST (Taiwan ROC) co-lead
- European Commission (EC) co-lead

Co-leads and Participants shall engage in the support of the Coordination Office by advising on work plans, roles, methodology and protocols for the Office in accordance with the objectives listed below. Co-leads and participants are further expected to provide support for their participation in the Science Advisory Board, to support travel to and from relevant meetings, and to represent Coordination Office activities where appropriate. Participants may further support these activities by acting as national communications officers to disseminate information to and from agencies and stakeholders within their own spheres of influence.

<u>Near Term – 0-2 years</u>

Action	Objective	Timeline/Participants
Allocate Resources and Roles (with input from other Action Themes)	Determine and allocate resources, terms of support from co-leaders and participants to develop work plans for Action Theme Champions.	Q1-2 2016
Establish and Fill Role of Coordination Officer and AT 1 Champion	Co-leaders and participants define duties and qualifications of Coordination Officer and develop work plans for Action Theme Champion.	Q1-2 2016
Establish Communication, Collaboration and Coordination Office with internal Terms of Reference and operations plan	Define duties and qualifications of Coordination Officer and interactions with rest of Action Theme members. Set up communications plan with goals and schedule.	Q1-2 2016
Establish Strategic Coordination Network	Identify and recruit representatives of SCN and define priorities for their input in other Action Theme activities.	Q2-Q3 collaborative - all participating agencies represented on this board
Map the Landscape	Create and disseminate "Map of the Landscape" application to inform participants and stakeholders of global	Q3- first iteration (ongoing)

Action	Objective	Timeline/Participants
	e-infrastructure and data management activities.	
Support Coordination of Implementation Plan Elements	Host annual meeting of Action Theme Champions and representatives from the Belmont Forum Secretariat, SCN, and associates: What's working and what's not; opportunities, challenges, and recommendations.	Q3-4 2016 (International Data Week?)
6 Yearly and Quarterly progress reports	Describe overall activities.	Q4- ongoing

Medium and Long Term – 1-5 years

Action	Objective	Timeline/Participants
Outreach and communication	Create outreach plan for BF members, stakeholders on results of Near Term activities.	Q1 2017
Continue Development of Strategic Coordination Network	Identify and recruit representatives of SCN and further refine priorities for their input in other Action Theme activities.	Q1-Q4 2017 collaborative - all participating agencies represented on this board
Ongoing support and management	Liaise with boards and networks (working with Data Information Officer), refine protocols for interaction with Belmont Forum Secretariat and Theme Champions, establishment of project evaluation tactics

Turn the implementation actions into an effective process for e-infrastructure with recommendations for Belmont Forum funding actions, policy adoption, and operational requirements. | Ongoing |

	These programs should also be aimed at data stewards in order to share best practice internationally.	

Roles and Responsibilities

A virtual Communication, Collaboration, and Coordination Office will be established by the U.S. National Science Foundation and additional project leads. It is anticipated that this office must have at least the equivalent of two full time employees (FTEs) to function effectively, and to creatively leverage additional resources to ensure its efficacy. As of March 2016, the NSF has funded the Coordination Office at this level along with necessary operational and travel expenses to launch Action Theme 1.

Funding includes support of a Coordination Officer, a high level position which includes executing the recommendations of the Secretariat Coordinating Group, overseeing office staff, outreach and communications, and coordinating and supporting activities of the three additional Action Themes. Additional positions include support staff and an Action Theme Champion.

It is anticipated that all participating organizations will contribute by:

- Providing representatives to the boards, committees, and groups as appropriate
- Hosting or participating in virtual and in-person meetings for the planning and conduct of the Action Theme
- Maintaining engagement with the Strategic Coordination Network
- Identifying and committing resources as available to the successful implementation of the Action Theme

Initial duties of the Coordination Office include proposing organization of the leaders, participants and observers within the Action Theme to carry out its tasks, in a framework that is flexible to accommodate new commitments from others on the team. A second element is to formalize an organizational structure for coordination of all the Action Themes and communication protocol for interactions with stakeholders, working groups, the SCG, SAB, and GPC.

The Coordination Office role will be to:

- Oversee and coordinate tasks relating to all four Action Themes under the supervision of a Communication, Collaboration, and Coordination Officer (Coordination Officer)
- Field an Action Theme Champion
- Set structure and schedule for stakeholder and board meetings and provide updates to Champions at regular intervals

- Maintain contact and communication with BF Secretariat
- Establish organizational framework and lines of communication with Action Theme 1 co-leads, Action Theme Champions, Belmont Forum Secretariat, and additional stakeholders
- Support the SCG in their duty to steer development of collaborative Action Theme activities
- Support an e-Infrastructure Science Advisory Board of representatives of Belmont Forum members
- Establish and manage the SCN
- Assist other Action Themes in maintaining their lists and databases
- Work with the SCN to develop an outreach plan for stakeholder organizations to adopt or to disseminate results and products, including training materials

E-I&DM Action Theme 2: Data Planning

Expected Outcomes

This Action Theme will help to promote active and effective data management and stewardship in all Belmont Forum funded research, and enable harmonization of e-infrastructure through enhanced project data planning, monitoring, review and sharing.

1. Convene and oversee a Data Policy Work Group and Security Work Group
2. Generate an Enhanced Data Plan (EDP) template for use in Belmont Forum funded research. The EDP should cover the management of data, connection of the data to associated context (research project, resulting publications, researcher details, data provenance, etc.), facilitating the discoverability of the data, and ensuring that the data is capable of reuse/exploitation.
3. Assign budget requirements for implementation and sustainability of proposed data management plan; develop an incentive system to promote adoption of EDP and associated data management practices.
4. Develop evaluation processes and matrices to ensure continued efficacy of EDP.

Scope and Partners

The scope of this Action Theme, as described in the CSIP, calls for the Belmont Forum to foster communicating best practice in data and information stewardship paying attention to the full lifecycle of data use and the rates at which information is gleaned from data; evolve policies to promote better and more effective data planning; adopt data stewardship principles; and implement incentives for their adoption, similar to the ways in which scientists are incentivized to publish research results. Current Data Management Plan (DMP) requirements vary greatly across Belmont Forum agencies in their level of detail and compliance with general stewardship principles, including use of certified, trusted data repositories. DMPs do not generally include sufficient guidance on current best practice and available e-infrastructure, and how to enable data exploitation. Furthermore, there is often little or no formal accountability to ensure DMPs accomplish what is proposed or to learn from their success or failure.

The Action Theme proposes the following activities at an early stage:

- Identify support to appoint a full time Data Information Officer to work closely with the Coordination Office and the additional Action Themes
- Review existing Data Management Plans, templates, and forms, with the goal to adopt a common minimum Enhanced Data Plan (EDP) template
- With Coordination Office, identify and liaise with existing data security and data policy groups

- Coordinate input from boards and other Action Themes, notably the workshop participants from Action Theme 3, to develop Enhanced Data Plan template for use in Belmont Forum projects
- Establish mechanisms for regular review and monitoring of Enhanced Data Plan accomplishments and effectiveness
- Oversee best practices for preparation of Enhanced Data Plan
- Assign budget requirements for Enhanced Data Plan implementation, including data curation and publishing costs, to be factored in funding agency standard grant policy
- Draft a plan to extend the current reward system associated with grant awards to include a conditional sharing and sustainable archiving requirement to complete the data lifecycle, and to reinforce successful implementation of Enhanced Data Plans

The agencies that have expressed their willingness to lead this Action Theme are:

- NSF (USA) lead
- JST (Japan) co- lead
- NERC (UK) co-lead

NSF has agreed to supply a full time Data Information Officer whose qualifications include a Ph.D in Data Systems or comparable qualifications through the NSF Fellows program. This position must be assisted by in-kind support in expertise and resources from theme co-leads and participants and the Coordination Office. Recruitment for this position will be circulated in April, 2016.

There is a strong possibility that the role of Action Theme 2 Champion will be supported by NERC and will begin in September 2016.

Near Term – 0-2 years

Action	Objective	Timeline/Participants
Allocate Resources and Roles	Establish resources, terms of support, and implementation schedule for Action Theme.	Q1-2 2016
Establish and Fill Roles of Data Information Officer and AT2 Champion	Define duties and qualifications of Data Information Officer from co-leaders and participants and develop work plans for Action Theme Champion.	Q1-2 2016

Establish liaisons to Security Working Groups and Data Policy Working Groups	Leverage existing connections within known organizations such as RDA, CODATA, WDS, to pull relevant information back to the SCG	Q1-3 2016 - collaborative
Develop Enhanced Data Plan Template based on results from analysis workshop	The EDP is intended to be used to support implementation of the Data Principles and Policy adopted by the Belmont Forum.	Q3-4 2016
Evaluation metrics for Enhanced Data Plans	Develop and maintain a set of metrics to assess compliance with the Belmont Forum-funded Enhanced Data Plans, based on input from AT 3 workshops.	Q3-4 2016
Integration into CRAs (With AT3- Call Finalization)	Integrate EDT and Data Management Plan into BF funding calls	Q4 2017

Medium and Long Term – 1-5 years

Action	Objective	Timeline/Participants
Carry Out Data Planning Goals and Activities	Oversee goals, activities, and accomplishments of Data Information Officer. These programs should also be aimed at data stewards in order to share best practice internationally.	ongoing
Monitor Implementation of Data Plans and update data plan accordingly	Review and monitor implementation of the Enhanced Data Plans, starting with funded research projects under the Belmont Forum initiative, to determine efficacy and make recommendations to the Belmont Forum for additional actions or policies. Update where necessary.	Q2 2017/ongoing
Identify Key Data Repositories	Key data repositories - preferably certified, trusted repositories - relevant to the Belmont Forum research agenda can serve as exemplars for the Enhanced Data Plans. (The ICSU World	Q2 2017

	[Data System](#) and [re3data](#) initiatives were identified as two of the useful resources to identify trusted digital repositories.) Feed this information to Coordination Office to add to Map of Landscape	
Gap Analysis	Determine what Belmont Forum data are *not* in trusted repositories and explore ways to ensure compliance. Update Enhanced Data Plan template accordingly.	Q1 2018

Roles and Responsibilities

The Data Planning and Stewardship Action Theme is expected to be led by a Data Information Officer and Action Theme 2 Champion working in close association to the Coordination Office. Primary duties include:

- Data Information Officer (with the support of the Coordination Office) to establish ties to a Security Advisory Work Group (SecWG) to oversee relevant security issues and contribute to the development of the Enhanced Data Plan template
- Data Information Officer (with the support of the Coordination Office) to establish ties to a Data Policy Work Group (DPWG) to oversee relevant legal issues and contribute toward the development of the Enhanced Data Plan template
- Work conjointly with the co-leads (JST, NRF, and NSF) and with a correspondent of each partner agency to develop a strategic plan with resource loading and timeline for achieving long term goals of the Action Theme
- Provide support, when relevant, to Work Groups
- Synthesize information and submit reports and recommendations to the Coordination Office and SCG
- With Coordination Office, schedule regular conference calls with Action Theme Champions to ensure integration of outcomes from scoping workshops and into training criteria

It is anticipated that all participating organizations will contribute by:

- Regularly participating in virtual and in-person meetings for the planning and conduct of the Action Theme
- Identifying and committing resources to the successful implementation of the Action Theme

E-I&DM Action Theme 3: e-Infrastructure

Expected Outcomes

This Action Theme expects to attain the following objectives:
1. Identify and fund interdisciplinary use-cases of combined data- and e-infrastructure for environmental and global change problems.
2. Identify and fund large-scale Data and Model Intercomparison Projects that are relevant to global change research.
3. Through the above two outcomes, inform data- and e-infrastructure policy with case-proven best practices that respond to concrete issues.

Scope and Partners

The scope, as described in the CSIP, calls for the Belmont Forum to implement iterative cycles of scoping workshops and international calls for research-driven case studies of the way researchers are synergistically using data and e-infrastructures in large interdisciplinary investigations. The overall objective is to determine best practice and develop concepts and prototypes through case studies that illustrate the full cycle of data use and reuse. This Action Theme will identify existing cross-disciplinary research projects already being carried out under Belmont Forum, Future Earth, and other international initiatives and build on them.

The Action Theme proposes a multi-stage process, consisting of cycles of:

➢ Scoping workshops, beginning in 2016 and continuing in 2017.
➢ Promulgating calls for proposals, presented to BF principals for approval in 2017 and 2018.
➢ Annual evaluations of the coherence and impacts of the above two efforts.

The Action Theme proposes the following activities at an early stage:

● Plan and coordinate an initial series of scoping workshops.
● Establish remote collaboration for the elaboration of conclusions, recommendations in coordination with the other Themes (Data Planning, Human Dimensions) and the Coordination Office between each workshop.
● Following the outcomes of the workshops, organize phases of finalization of competitive call proposals, with the Coordination Office.

The agencies that have expressed their willingness to lead this Action Theme are:

- ANR (France) lead
- JST (Japan) co-lead
- MOST (Taiwan ROC) co-lead

Near Term – 0-2 years

Action	Objective	Timeline/Participants
1. Allocate Resources and Roles	Establish resources, terms of support, and implementation schedule for Action Theme.	Q2 2016
2. Establish and Fill Role of e-Infrastructure Officer and Champion	Define duties and qualifications of e-Infrastructure Officer, Champion and co-Champion from leader, co-leaders and participants. Develop work plans for Action Theme Champion.	Q2 2016
3. Coordinate/ Organize the Evaluation Matrix Elaboration	Development of the Evaluation Matrix, which will be used to analyze, score and identify cross-disciplinary case studies, and the broader scope of the relationship between environmental science, data and e-infrastructure.	collaborative/remote – Q2 2016

Action	Objective	Timeline/Participants
4. Inter-workshop Coordination	Coordinate remote collaboration (= shared documents) for the elaboration of conclusions, recommendations in coordination with the other Action Themes (Data Planning, Human Dimensions) and the Coordination Office.	Q2-Q3 2016
5. Coordinate/ Organize the Analysis Workshop	Analyze cross- and transdisciplinary scientific use cases of existing Belmont Forum-funded and Future Earth projects and other international initiatives, using the derived Evaluation Matrix. Liaise with the associated communities and identify critical gaps and barriers. Define any	collaborative - Q3 2016

	required funding calls and priorities for task-oriented multi- and interdisciplinary case studies.	
6. Hold Analysis Workshop	Hold workshop. With DIO (Data Information Officer), update the Evaluation Matrix in light of the Analysis. Draw conclusions for informing the Training and Data Management action themes. Prepare and submit a BF call proposal in coordination with existing initiatives of RDA, GEO/GEOSS , and the CRE (Coordinated Research on E-Infrastructures) initiative led by EC, NSF and ANDS.	Q3 2016 / **EC**, ANR, JST, MOST
7. Hold DMIP Workshop	Hold DMIP workshop (back-to-back with the Analysis Workshop). With DIO, update the Evaluation Matrix in light of the Analysis. Draw conclusions for informing the Training and Data Management action themes. Coordinate with CRE initiative. Prepare a competitive call for BF approval.	Q3 2016 / **JST**, ANR, NSF, EC, MOST
8. Call Finalization	*If approved by the 12th Belmont Forum*, finalization of the competitive call proposal, with the Coordination Office.	Q4 2016

Medium and Long Term – 1-5 years

Action	Objective	Timeline/Participants
1. Carry Out e-Infrastructure Goals and Activities	Elaborate e-infra competitive call proposal for selection of pilot inter-and trans-disciplinary use cases and projects in 2017 to be submitted to 12th Belmont Forum in November 2016. Elaborate e-infra competitive call proposal for selection of Data and Model Intercomparison projects in	ongoing

	2018, to be submitted to the Belmont Forum in November 2016. Oversee goals, activities, and accomplishments of e-Infrastructure activities.	
2. Organize Annual Meetings	Organize annual follow-up meetings of the call to steer interactions and confrontations between the selected pilot projects and communities and to develop a mutual understanding, concepts and prototypes that address well identified barriers and gaps to be addressed in synergy. Link up with progress analysis of the pilot projects retained in the call. Inform the Training and Data Planning action themes	End 2017, 2018, 2019
3. Organize Continuous, Intra-annual Analysis	Organize the continuous analysis of the three-year inter- and trans-disciplinary case studies and pilot projects call, and the DMIP call. This should include (see diagram below) a series of workshops during the call. This is different from the annual meetings.	2016-2018
4. Inform Data Planning Action	Inform the Data Planning Action with a set of beacons of good practice and recommended international standards, to define the strategy and the priorities for the co-evolution of the data e-infrastructure in harmony with the interdisciplinary research needs: improving the use of data by maximizing the overall value of generating, collecting, preserving, curating and archiving data; and delivering decision support to application science.	2016, 2017
5. Inform Human Dimensions Action	Inform the training plan with a set of "intellectual ramps" and training/education needs drawn from	2016, 2017

	the identified beacons of good practice, new inter- and transdisciplinary methods, tools and practice.	
6. Data e-Infrastructure Recommendations	Elaborate a set of recommendations for exemplary data e-infrastructures and research practice based on the analysis of the call results.	2018
7. Final Annual Meeting and Next Steps Workshop	At Annual Meeting, host "Next Steps" Workshop on use and integration of data templates for representatives for national, regional, and international organizations	Q4 2018

Roles and Responsibilities

The e-Infrastructure Action Theme is expected to be led by a Champion hosted at ANR. The Champion's role is to:

- Coordinate with the co-lead(s) of the action.
- Coordinate with the co-lead the analysis and reporting between and from each workshop.
- Send information back to and coordinate with the Coordination Office.
- Coordinate the action secretariat.
- Work conjointly with the co-leads (JST, MOST), the participants (EC, NSF, NERC, FAPESP, MOST, NRC, CSIRO …) and with a correspondent of each participating organization, as well as members of the Strategic Coordination Network and boards as applicable.
- During the duration of the calls (three years), drive the calls with annual meetings (one per year) - not a "kick-off + final review" approach, but rather an annual follow-up with recommendations for interactions and confrontations between projects and communities (see Medium-Term Actions 2 and 3 above).
- Maintain pertinence with the most recent Information and Communications Technology (ICT) and research evolutions
- Aspire to have recommendations (that can be adopted, i.e., have a measurable payoff) and prototypes coming out of each project, at a yearly rate.
- Identify outstanding challenges, and paths to resolve them.

The above will contribute to create and maintain a momentum, bringing together research, analysis and redirection, throughout the duration of the call.

The action secretariat will be primarily housed at ANR and co-located with the existing Belmont Forum Secretariat already on site. The action secretariat will:

- Coordinate sub-actions and handle continuity in between
- Coordinate with the BF secretariat direction and the Coordination Office - reception and transmission
- Assist the Champion and the co-Champion with pre-selection procedure and global running of the action

The lead and co-lead will share the initial workload by successively organizing and hosting the Phase 1 workshops.
- JST, MOST and ANR coordinate the construction of the Evaluation Matrix. Target date: June 2016.
- ANR, JST and MOST prepare, and EC hosts Analysis Workshop in Brussels - choice of projects that are representative and in coordination with the CRE initiative of DG-CNECT (see above). Iteration to elaborate a digest. Target date: 1st week of September 2016.
- JST, ANR, MOST and NSF prepare and host DMIP Workshop (analysis of DMIP and call scoping) in Brussels. Target date: 1st week of September 2016 (back-to-back with Analysis Workshop).
- Convene a meeting during the International Data Week in Denver to present, discuss, broaden participation and finalize the calls that have been elaborated in the Workshops. Target date: 11th September 2016.

It is anticipated that all participating organizations (MOST, FAPESP, NERC, NRF, CSIRO, EC) will contribute by:

- Regularly participating in virtual and in-person meetings for the planning and conduct of the Action Theme
- Covering the travel costs of their invitees to the workshops
- Identifying and committing resources to the successful implementation of the Action Theme

An important role is to engage during this action both a coordination and a collaboration with other international top-down and bottom-up initiatives such as RDA, GEO/GEOSS, and others like ICDP and the international Coordinated Research on E-Infrastructure (CRE) initiative.

Resources
The co-leads (ANR, JST, MOST) share the hosting costs of the workshops that they organize. The remaining participants contribute to travel costs of invitees. Call support follows the established Belmont Forum scheme, where each participating agency finances their own teams' research.

Schedule

Two back-to-back workshops are planned in Phase 1.Table 1 below summarizes the schedule and the projected costs.

Table 1: Summary of the Action Theme 3 (e-Infrastructure) schedule, with projected costs.

Action	Date	No. Participants	Host	Projected Cost k€
1. Matrix Analysis preparation	May -Sep 2016	-	virtual	0
2. Use Cases Analysis Workshop	Sep 2016	25-30	Brussels, Belgium	25
3. DMIP and Call Scoping Workshop	September 2016	25-30	Brussels, Belgium	25

Actionss 2 & 3 will prepare the 2017 call that will be submitted for approval to the Belmont Forum principals at the end of October 2016. Subsequent iteration workshops, to be held in 2017, will prepare the 2018 call that will be submitted for approval to the Belmont Forum principals in October 2017.

The overall Action is composed of a cycle-up series of scoping workshops followed by competitive international case studies calls as illustrated in the following timeline (Figure 2).
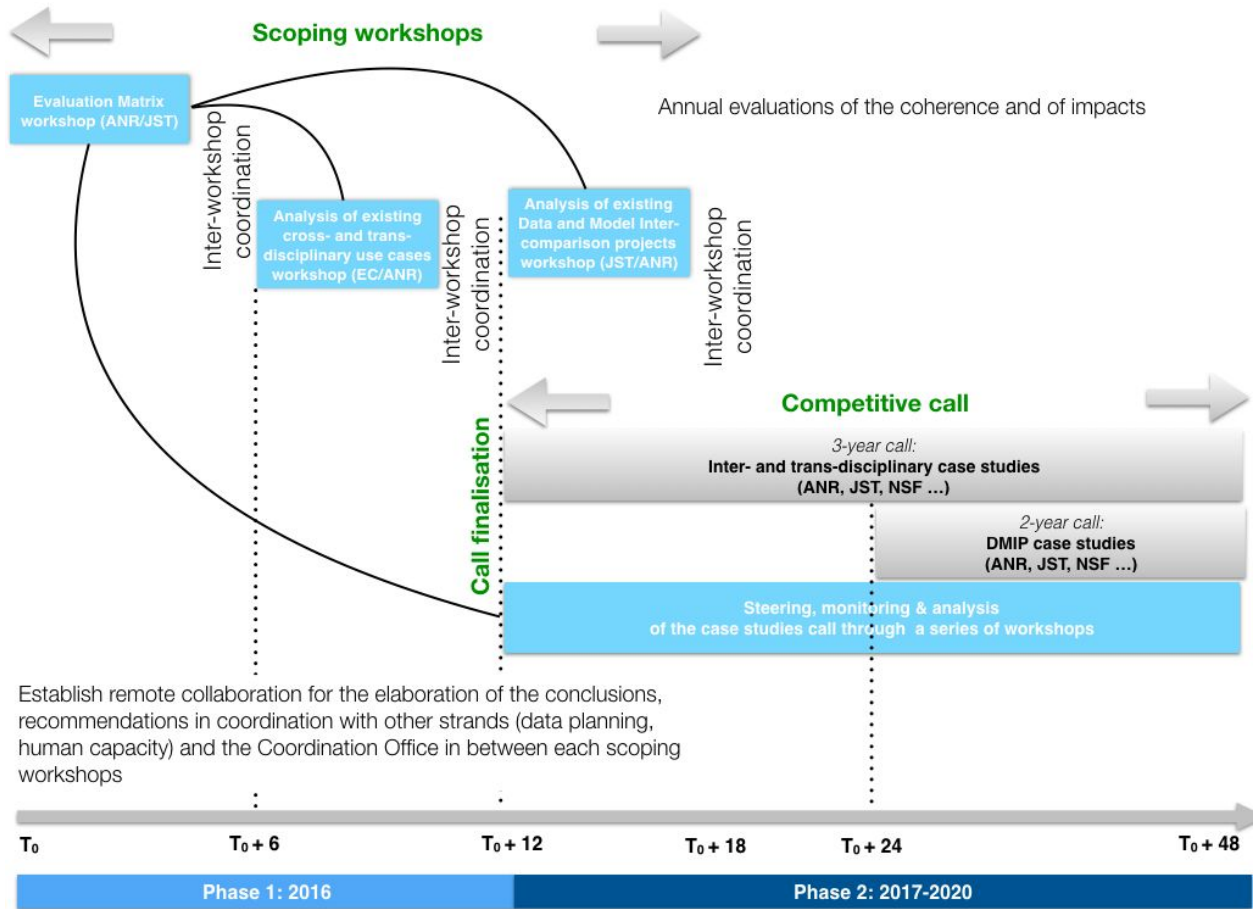
Figure 2: Proposed timeline for Action Theme 3 (e-Infrastructure)

E-I&DM Action Theme 4: Human Dimensions

PLEASE NOTE: Details of this theme are pending internal review and final approval by NERC.

Expected Outcomes

Overall objectives include:

1. Investigate resource gaps, training, and skills
2. Identify, promote, or develop cross-disciplinary education and training
3. Ensure sustainable human resources
4. Consider education and training requirements across all work packages (Action Themes) to identify possible areas where the Belmont Forum could contribute

Scope and Partners

The scope of this Action Theme as described in the CSIP, calls for the Belmont Forum to define an overall curriculum of training modules, which are necessary to support the objectives of the Belmont Forum. Key to this will be to ensure that good practice is identified, shared and propagated.

This action may require decisions on funding calls to be made outside of the standard Belmont Forum plenary process.

The Action Theme proposes the following activities at an early stage:

- Identification of existing training activities being provided nationally and internationally, beginning in 2016
- Scoping Workshop to define the overall curriculum, late 2016
- Calls for Proposals for courses initially based on existing provision, which address the curriculum identified, from mid 2017
- Annual review of curriculum, to incorporate evidence and outputs of other Themes

The agencies that have expressed their willingness to lead this Action Theme are:

- NERC (UK) lead

Action	Objective	Timeline/Participants
1 Allocate Resources and Roles	Establish resources, terms of support, and implementation schedule for Action Theme.	Q1 2016
2 Establish and Fill Role of Human Dimensions Champion	Appoint a Human Dimensions Champion (HDC) to oversee activities, coordinate with activities from other Action Themes, and liaise with Belmont Forum funded projects and the new Belmont Forum Secretariat. Recruitment process in Q1, HDC to start post in Q2.	Q1-2 2016
3 Identify Existing Initiatives	Working through the Coordination Office, the HDC should ask all Belmont Forum members and others to identify existing training initiatives being provided in this area.	Q2-3 2016
4 Create and Maintain Database	The Coordination Office should create and maintain an accessible database of these training initiatives.	Ongoing for lifetime of project
5 Define Curriculum	The HDC, with the Coordination Office, should organize a scoping workshop to define an overall curriculum for a program of short courses delivering skills and knowledge in 'Informatics for Human and Environmental Science'.Action Theme participants to support the travel and subsistence costs of their invitees to the workshop.	NERC to host - Q4 2016
6 Call for Training Courses	The Belmont Forum should start to scope a competitive funding call for the delivery of training courses against this curriculum based on existing successful courses or on newly proposed courses.	Q2 2017

Action	Objectives	Timeline/Participants
7 Call for "Belmont Forum Compliant" Short Courses	[tentative, dependent on previous call/activity.] An additional competitive funding call should be initiated for the design and delivery of short courses, which incorporate the recommendations of this report, including both environmental and relevant aspects of social sciences, as well as informatics. The purpose of the call would be to make nationally funded short courses Belmont Forum compliant, and then allow people in other Belmont Forum member countries to attend these courses if they are qualified and would benefit from the training.	Q-4 2017

Medium and Long Term – 1-5 years

Action	Objectives	Timeline/Participants
1 Call to Develop Online Training Programs	[This action is tentative and depends on the outcomes of the previous calls and activities under action theme 4 to assess what is appropriate.] Belmont Forum to initiate a subsequent competitive funding call to develop existing exemplars and results from the funding calls, into online training programs. These should incorporate on-going developments in data plans and e-infrastructure, to ensure that trainees have the capabilities and tools to pass on their skills to their local communities. These programs should also be aimed at data stewards in order to share best practice internationally.	Q2 2018
2 Course Provision and Evolution	Belmont Forum funding should be provided for the continuing provision and updating of the courses particularly to utilize new and innovative delivery mechanisms. Individual Belmont Forum member agencies may separately	ongoing

	allocate funds for appropriate students and scientists to attend international short courses and summer schools to better prepare them to compete in data-enabled activities.	

Additional Detail

Each attendee (both for the workshop and for any courses) should be responsible for their own costs, whether supported by their Belmont Forum member or from other sources. It would also be beneficial to include funding for students from non-Belmont Forum countries, particularly those from developing countries with little existing national training. An aspect of the training will be to provide data management skills for environmental scientists generally and to support the general responsibility of all scientists to archive data for long-term interoperability. Participants in the short courses could then use the materials and online tools to run other courses to promote good practice and cascade the skills more widely in their respective communities. It could be a condition of funding that they promulgate the training locally.

Roles and Responsibilities

The Human Dimensions Champion (HDC) will be hosted by NERC. The Champion's role will be to:

- Coordinate the identification and analysis of existing provision and gaps across all Belmont Forum countries and the organization of a scoping workshop
- Consider how we can better utilize and gain added value from existing activities across all Belmont Forum members
- Consider at what stages of the "career pipeline" skills and training needs should be addressed
- Bring expertise, courses, facilities etc. to bear from across member countries
- Consider how Belmont Forum partners can maximize participation in training activities individually and collectively
- Collaborate and liaise closely with the Coordination Office and other Theme Champions
- Ensure that information about the provision of courses is disseminated widely

It is anticipated that this role will be of the order of 0.2 FTE.

It is anticipated that all participating organizations will contribute by:

- Identifying training provision in their country or region
- Supporting the travel costs of their invitees to the workshop

- Disseminating and promoting information and training opportunities in their country or region
- Linking their national doctoral training programs/centers into the training activities identified

Terms of Engagement: Collaboration with External Organizations

The Belmont Forum has developed productive working relationships with many organizations that share similar goals and objectives across the e-Infrastructure and Data Management landscape. In accordance with the recommendations of Community Strategy and Implementation Plan developed by the e-Infrastructure and Data Management Collaborative Research Agreement, the succeeding implementation project(s) shall nurture relationships with relevant organizations to achieve maximum impact and knowledge of global Best Practices across this domain. Collaboration with such organizations is crucial to the success of this initiative and may occur in a number of ways: in communication roles related to the Communication, Collaboration and Coordination Office; as seats on the Strategic Coordination Network, the Security Advisory Board or the Data Policy Advisory Board; through participation in scoping activities; as representation in activities of the proposed Science Advisory Committee; or in additional collaborative roles.

All collaboration is subject to the following considerations:

Support for the participation of any organization is driven by the needs of this initiative and the community it works with in relation to the expertise and experience put forward by that organization.

Collaboration on this initiative is on the understanding that access to any subsequently arising calls for proposals, supported by the Belmont Forum, is on the basis of open competition as defined by Belmont Forum governance.

Any organization eligible to receive Belmont Forum funds[1], or able to provide its own funds, may submit bids into the competitive funding processes delineated by the e-infrastructure and Data Management Theme Program Office to increase its participation in development of the Action Themes.

Glossary of Terms

E-I&DM

    e-Infrastructure and Data Management Collaborative Research Action. Phase One (scoping) occurred 2013-2015. Phase Two (implementation) began December 2015.

CRA

    Collaborative Research Action. A project administered through the Belmont Forum with funding from at least three participating member countries.

SecAB

    Security Advisory Board. A group of data security experts convened through the E-I&DM to provide input and feedback on data security issues and Best Practices involving data security. It is expected that most representatives on this board will be drawn from members of existing data management groups or coalitions.

DPAB

    Data Policy Advisory Board. A group of data policy experts convened through the E-I&DM to provide input and feedback on challenges, innovations, other relevant issues and Best Practices involving data policy. It is expected that most representatives on this board will be drawn from members of existing data management groups or coalitions.

GPC

    Group of Program Coordinators

CSIP

    Community Strategy and Implementation Plan

CODATA - Committee on Data for Science and Technology - codata.org

    CODATA was established in 1966 by the International Council for Science (ICSU) to promote and encourage, on a worldwide basis, the compilation, evaluation and dissemination of reliable numerical data of importance to science and technology. It works to improve the quality, reliability, management and accessibility of data of importance to all fields of science and technology. It is a resource that provides scientists and engineers with access to international data activities for increased awareness, direct cooperation and new knowledge.

GEO - Group on Earth Observations - earthobservations.org

    Established in 2005, GEO is a voluntary partnership of governments and organizations that envisions "a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations and

information." GEO membership includes 96 nations, the European Commission, and 87 participating organizations comprised of international bodies with a mandate in Earth observations.

GEOSS - The Global Earth Observation System of Systems - earthobservations.org/geoss.php
The GEO community is creating a Global Earth Observation System of Systems (GEOSS) that will link Earth observation resources worldwide across multiple societal benefit areas - agriculture, biodiversity, climate, disasters, ecosystems, energy, health, water and weather - and make those resources available for better informed decision-making.

ESIP- Earth Science Information Partnership - esipfed.org
The ESIP Federation is an open, networked community that brings together science, data and information technology practitioners. Practitioners work together on interoperability efforts across Earth and environmental science allowing self-governed and directed groups to emerge around common issues, ebbing and flowing as the need for them arises. ESIP was founded in 1998 by NASA in response to a National Research Council (NRC) review of the Earth Observation System Data and Information System (EOSDIS).

Future Earth - futureearth.org
Future Earth is a major international research platform providing the knowledge and support to accelerate our transformations to a sustainable world. It will be an international hub to coordinate new, interdisciplinary approaches to research as well as being a platform for international engagement to ensure that knowledge is generated in partnership with society and users of science. The Governing Council of Future Earth is composed of members of the Science and Technology Alliance for Global Sustainability, an informal international partnership that is committed to making full use of science and technology to inform equitable, sustainable solutions to the most pressing issues currently confronting humankind. Future Earth is open to scientists of all disciplines, natural and social, as well as engineering, the humanities and law.

RDA - Research Data Alliance - rd-alliance.org
The RDA builds the social and technical bridges that enable open sharing of data. Its vision is researchers and innovators openly sharing data across technologies, disciplines, and countries to address the grand challenges of society. The RDA is supported by the European Commission, the U.S. NSF and other US agencies, and the Australian Government.

ICSU-WDS - International Council for Science World Data System - icsu-wds.org
The WDS is an Interdisciplinary Body of the International Council for Science (ICSU) created by its 29th General Assembly in Maputo, Mozambique in 2008. Its goals include: enabling universal and equitable access to quality-assured scientific data, data services,

products and information; ensuring long term data stewardship; fostering compliance to agreed-upon data standards and conventions; and providing mechanisms to facilitate and improve access to data and data products.

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[1] The Belmont Forum is not a funding body in its own right; "Belmont Forum funds" refers to the funding made available to the community from the participating Belmont Forum members, in response to calls for proposals.