

Rationale and Preamble

This section discusses the “nuts and bolts” of managing a large SES project. A sound management plan is essential from proposal development to project completion. It must be well crafted from the outset, but designed to be flexible and responsive as the project matures, incorporating input from investigators and key personnel. Your plan will need to establish policies and norms early on that are designed for the life of the project. Data management, attribution, and intellectual property issues are examples that can cause contention if not clearly articulated. On the other hand, flexibility will be required to cope with changing conditions and even changing requirements for data management within your funding agency. Issues including policies concerning data management and intellectual property necessarily require input from all investigators. Establishing how you will communicate across the project early – especially if you have many remote sites – will make the project run more smoothly (see Section 2, Molding the Team; and section 3, Culture of Collaboration).

Most of the elements in this section should be addressed in the proposal or early project stages. Keep in mind that people will be coming in and out of the project as it proceeds, requiring you to revisit all of these project management elements. To keep the project on task, you will need to continually revisit goals and milestones and make team members accountable for getting their work done according to the agreed work plan.

TABLE 7.1 CONSIDERATIONS FOR PROJECT DESIGN AND MANAGEMENT AT DIFFERENT PHASES THROUGHOUT A PROJECT	PHASE I	PHASE II	PHASE III	PHASE IV
	PROPOSAL	GETTING STARTED	PERFORMING	FINISHING STRONG
Develop an organizational infrastructure	x	x		
Hire a project manager	x	x		
Evaluate having a project CEO and COO	x	x		
Design a project attainable in budget and timeline	x	x		
Establish clear milestones and goals	x	x	x	
Reinforce expectations on milestones		x	x	
Collect baseline data and metrics		x		
Perform annual evaluation of progress		x	x	
Adopt adaptive management		x	x	
Develop an aspirational goal	x	x	x	x
Data management tasks	x	x		x
Develop shared vision for data management				
Develop data sharing infrastructure	x	x		
Develop data management plan	x	x		
Attribution – who gets credit for what		x	x	x
Develop an IP policy	x	x		

Organization

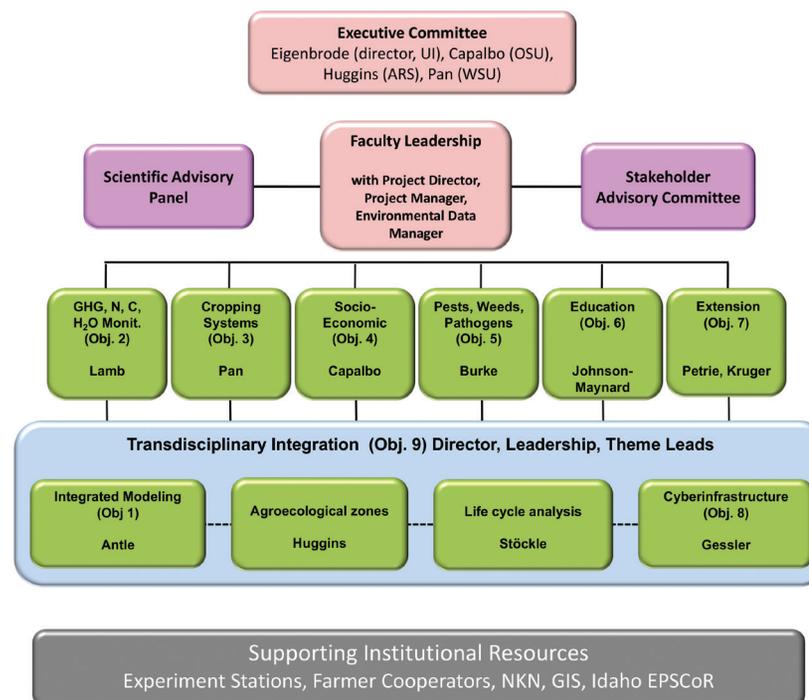
Develop an organizational infrastructure

You will need an efficient organization to support your high-performance team (HPT). This organization establishes clear reporting lines of responsibilities while ensuring that project participants have enough space to do their work and be creative. Large SES projects typically have dozens of investigators so you will need your co-PIs to serve as mid-level managers to keep the entire project going smoothly. As a rule of thumb, no one should be responsible for supervising more than about five people the project. Of course, people do the work, so you need to determine the size and composition of each sub-team necessary to complete the proposed tasks. It is easy to underestimate the resources required for project components as you design your project's organization.

Be realistic and perhaps even conservative in your assessment of how much work people can do in designing your project organization.

Your organizational structure will reflect specific project components but must also support the project's integrating objectives. Personnel may occupy multiple functional areas to facilitate flow of information across the project to support interdisciplinary and ensure that cross-cutting objectives are met. You can also form explicit cross-cutting teams in addition to the area specific teams to foster interdisciplinary activities. Supporting personnel can also work across project areas to support the exchange of ideas and information and to support cross-cutting activities.

FIGURE 7.1
EXAMPLE ORGANIZATIONAL CHARGE FOR A LARGE SES PROJECT



A meeting of a subteam of the USDA-NIFA sponsored REACCH project focused on pests, weeds, and diseases. Credit: Sanford Eigenbrode

The executive team

You are going to need an excellent project manager who can handle the budgeting, meeting planning, and other support issues of the project, freeing you to manage the scientific work. The importance of having a good project manager can't be stressed enough (see Section 2, Molding the Team). If substantial release time can be secured for two faculty, another successful organizational model includes a Project Director serving as the Chief Executive Officer (CEO) and a co-Project Director serving as a Chief Operating Officer (COO), with part-time administrative staff in supporting roles. Generally, the CEO is responsible for overall strategic direction of the project and for engaging with project stakeholders and the COO runs the project and engages with the co-PIs. These are time-consuming tasks, and sharing the workload will help ensure that things are done well and that neither of you will be burnt out. Further, since you can't be two places at once, it is nice to have a co-leader that can cover important events and meetings when you are not available. Large projects with dozens of investigators typically are managed through a hierarchical structure comprised of the executive team (Project Director and Project Manager, CEO and COO, or other structure) and a committee of team leaders (for objective-focused teams). If multiple institutions are involved it is helpful to include broad representation on these leadership teams, especially when tough decisions need to be made. Team leaders can meet periodically as a group, and they in turn can organize meetings of their contributing investigators and students.

Project advisors

Typically, your project will have formal advisors in the form of a representative stakeholder advisory committee, a scientific advisory panel, or both. The individuals on these groups will have long-term relationships with your project, attending or participating in annual meetings, accessing reports, and on some level participating in the genesis and metamorphosis of your team from formation to completion. Selecting these teams and attending carefully to their inputs and communicating their value

to your project's processes and successes will help elevate your performance. It is important to identify and attract members of these groups who themselves have stature in their fields and professions. Allocate adequate funding in your proposal to support their involvement in the form of stipends and support for travel to project meetings and other activities. Your scientific and stakeholder groups can be tremendous advocates for your project and assets as critical and astute observers.



A leadership team at work for the Center for Modeling Complex Interactions, University of Idaho. Credit: Anonymous

Project Objectives and Milestones

Project design

When you are assembling your proposal you need to be realistic about what can get done during the project’s time frame and within the allocated budget. With a large budget, there may be a temptation to think that there is more than enough money to do the work. Once the project is underway and all of the funds are distributed and committed, however, you may find that funding is indeed limiting. To avoid this issue, try to get someone knowledgeable about your area – such as your associate dean for research – to look over the project design to make sure it can be executed on time and on budget. There is a tendency among many PDs to overpromise at the proposal stage, in order to be competitive. The repercussions of doing this are amplified in very large SES proposals and projects. So, resist this temptation. Funding agencies are most unhappy when you don’t deliver on what was proposed.

- **Establish goals, objectives, milestones, and outcomes**

- Goals are the broad desired results of your project (e.g. lay the foundation for a renewable fuels industry), while outcomes are specific and ideally measurable immediate changes in knowledge, action, or situation that result from your project (e.g. a fermentation system that results in a 95% yield with a 50 g L-1 titer, or a 30% reduction in greenhouse gas emissions from a farm). Working with all of your co-PDs, you need to establish project goals, the objectives to support them, and the milestones required for completion of objectives. *An aspirational or capstone goal is important for unifying the team and setting the priorities across the entire project.* In addition, such a goal can help promote the project and can be used by the funding agency to support its programs – keeping everyone happy. It is best to have a goal that involves many project stakeholders, is achievable, and can be well documented once it is completed.

Project milestones should specifically lay out what will be accomplished, and by when. The “what” needs to be something that is measurable. A milestone chart or table that shows what will be done “when” is an excellent way to see how the project comes together and to help manage the work. The milestone chart will also help you manage cross-cutting elements of the project where the work of one group depends on the work of a second group to be completed. This semiformal Gantt charting approach has been adopted by most of the large SES projects of which we are aware. There are software packages designed to enable project Gantt charting, including Microsoft Project (https://en.wikipedia.org/wiki/Microsoft_Project), iMeet Central (www.pgi.com/imeet-central), and others. Whether you choose to use one of these, it will be helpful to review them to see what functionality could be adopted that is appropriate for your project. Either way you should consider having written and signed agreements from teams and individuals regarding who will do what work by when. This will formalize the expectation and could be helpful when reviewing your co-PIs’ progress and performance, and it will help them motivate their teams.



Meeting milestones together unites and energizes the team.
Credit: Anonymous



Meeting a milestone in the USDA-NIFA sponsored Northeast Woody “Warm-season” Biomass Consortium. Credit: Anonymous

ITEMS

OBJECTIVE 4

Determine social and economic factors influencing agricultural management, technology adoption, and development of policy to improve production efficiency while mitigating greenhouse gas emissions

TARGETS (MILESTONES AND DELIVERABLES FROM TABLE Q6.1)

- M4.1. Longitudinal and key informant interviews following AEZ strata conducted, Y1-5
- D4.5a. Spatial representation of adoption likelihood incorporating socioeconomic variability
- D4.5b. Socio-geographic functions for N, water, energy use shifts due to crop, policy, climate

CRITERIA AND METRICS (LISTED FOR EACH MILESTONE AND DELIVERABLE)

- M4.1. Subjects identified, interview design finalized, each round of interviews completed, data analyzed, report generated and communicated to Extension team and others
- D4.5a. Surveys designed, populations identified, surveys administered, surveys analyzed, maps generated from survey data, layer available for integration into synthetic models
- D4.5b. Successful strategies for optimal GHG mitigation identified by strata

ACTIONS AND REPORTING REQUIREMENTS	POINTS OF CONTACT	DUE DATES
M4.1. Initial round of key informant interviews completed	Painter	Jan. 2012
M4.1. Additional rounds completed	Painter	Jan. 2013-2015
M4.1. Analysis of longitudinal surveys completed and published; data communicated to other team members	Painter	
M4.5a. Surveys designed and administered	Wulfhorst	Jan. 2013
D4.5a Manuscript on adoption likelihood by strategy and strata	Painter and Wulfhorst	Jan. 2015
D5.4b. Manuscript, document for producers and stakeholders	Pan, with others (see)	Jan. 2015
All. Hiring personnel completed		Aug. 2011
All. Graduate student recruited		
CROSS-PROJECT INTEGRATION ACTIVITIES	POINTS OF CONTACT	DUE DATES
Regional assessment of socioeconomic barriers and drivers of adoption of climate adaptation and mitigation, incorporating AEZ and LCA	Painter, Wulfhorst, Capalbo, Huggins, Stockle	Jan. 2015
Graduate students recruited and integrated with those associated with other objectives	Wulfhorst, Johnson-Maynard, other PIs	Sept. 2012

FIGURE 7.2
EXAMPLE OF A PROJECT MILESTONE CHART FOR A PORTION (SINGLE OBJECTIVE) OF ONE PROJECT.

M OR D = MILESTONE OR DELIVERABLE, OBJECTIVE NUMBER (1-9).

Reinforce expectations milestones

Goals and milestones are not useful unless they are monitored and enforced. It is important that you establish an expectation of accountability at the beginning of the project and then maintain that through its life. Annual reviews, discussed below, are good opportunities to reinforce the importance of meeting milestones and your commitment to the work being done as promised and on time.

Collect baseline data

At the end of the project you will be asked, “What did you accomplish?” It is almost impossible to answer this unless you have baseline data on the state of things when you started and mechanisms to acquire comparable data to measure the outcomes and impacts of your project. Depending on your project, these could include data documenting stakeholder practices, levels of knowledge of concepts, adoption of technology, or changes in conditions. Some of this may be available through third-party sources, but you will likely want targeted information that can measure changes within the timeframe of your project for reporting purposes.

Periodic evaluation of progress on objectives and milestones

Periodic reviews of progress against milestones are essential to ensure that the work is being accomplished and to inform you of what is in process and what is completed in the project. This review can take the form of required reports, presentations, or symposia. Progress toward goals and milestones are reviewed regularly as well as proposed work for the coming months and years. Most projects will conduct performance reviews annually (coinciding with agency reporting requirements), but some large SES projects have required quarterly written reports from objective teams or from institutional partners. These reporting requirements will only be effective if tied to consequences or rewards

concerning the distribution of funding. Resources can and should be reallocated where they are needed to meet milestones and emerging challenges, ideas, and approaches. Performance-linked subcontracting must be established at project inception so that there is buy-in. Some SES projects without these kinds of rigorous provisions have suffered from delays and inefficiencies in achieving milestones.

Process based assessment

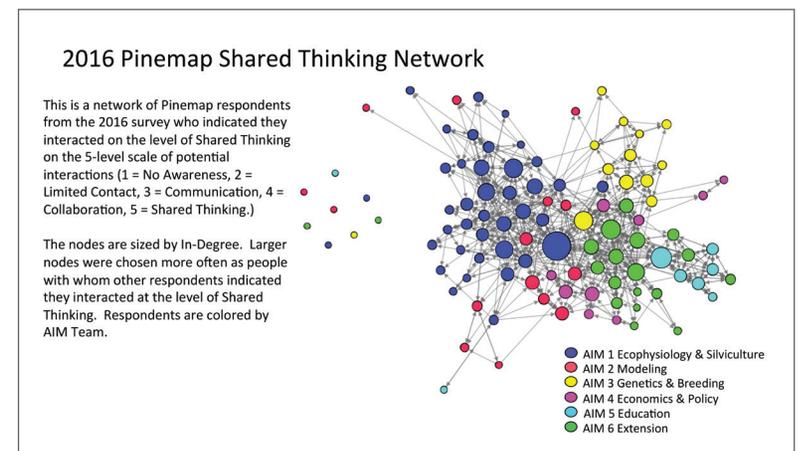
Assessment is not limited to measures of progress towards and achievement of milestones and deliverables. It also should be designed to determine how the project itself functions as a human system. Periodic surveys of participant views on how the project is functioning, what issues individual participants may be encountering, participant sense

of understanding of the project as a whole, and their involvement and other matters can help assess overall project functioning. These surveys can be invaluable for adjusting management approaches and informing protocols to address them. Most successful projects have conducted these kinds of surveys annually. For some projects, process-based assessments have used approaches such as social network analysis surveys (Scott 2013) to determine the communication and collaboration patterns and challenges within a project as a tool for management and for the project as a whole to understand the project enterprise (Fig. 7.3). Assessment activities of any kind require expertise and effort. Whether or not your agency or its RFP requires it, plan to build in the costs of regular assessment. A good project assessment team can become integral to project cohesiveness and buy-in by all participants.

FIGURE 7.3 SOCIAL NETWORK ANALYSIS (SNA) DIAGRAM OF A LARGE SES PROJECT (PINEMAP).

Each node is a project participant and lines show interactions between participants. This visualization shows participants who collaborated at a level of “shared thinking,” the highest level of interaction on a 5-point scale. Larger symbols indicate participants who interacted at a level of shared thinking with larger numbers of other participants. This type of visualization allows identification of key individuals, collaborative structures, and potential gaps, information very useful for leadership planning.

Credit: M.C. Matthews and W.L. Bartels, unpublished data

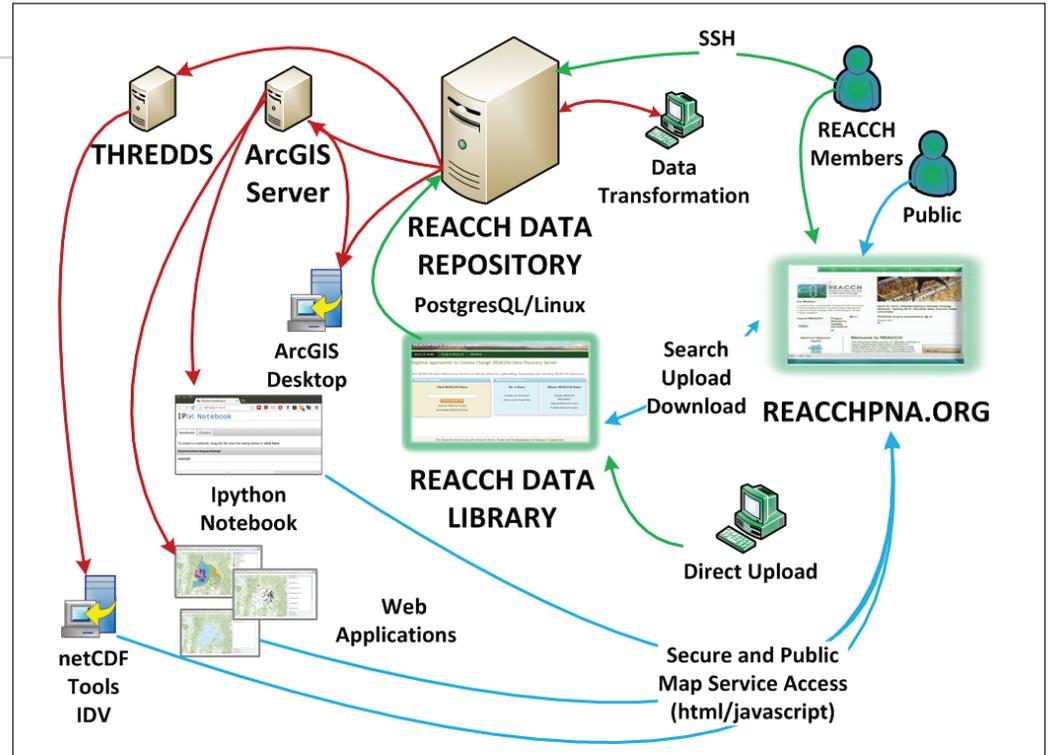


Adaptive management

You are directing a large research project with many components, and some things won't work out, the world changes – unless your funding agency constrains you, try not to sweat it. Milestones need not be set in stone. Some things don't work out and there can be slippage in time lines. Indeed, funding agencies typically have provisions for modifying the specifics of project milestones (if not objectives) and resetting them appropriately in response to changing conditions or unforeseen difficulties. The inevitability of contingencies should be acknowledged across the team and managed creatively. You will need an explicit adaptive management strategy to deal with these dynamics. The periodic or annual review of all the project goals and milestones with your leadership team is an effective venue for managing these sorts of changes in your project. The periodic annual review should be holistic, re-envisioning your project based on what you have accomplished and changing conditions. It is important that the funding agency be part of this conversation and that you get buy-in from them on any changes you want to make in the project's direction. While funding agencies prefer that the project accomplish what was proposed, most program managers understand a changing world and the need to be flexible in managing the project.

Data and Information Management

Large SES projects will have lots of data of different types and acquired in a variety of ways. Many of these data will be shared in the integrating elements of the project. You will need to have personnel expressly dedicated and with the expertise to assist with data management. Data management efforts across the project must be guided by a formal data management plan that defines the location, form, and protocols for storing and accessing project-generated data. The data plan needs to be familiar to all project personnel who will be contributing data. It must be reviewed annually or more often to ensure it is working for all of the members of the project and all incoming data types. All of the project members need to abide by the data plan so that critical data are not lost and are made accessible to other team members that need the data for their work, and are archived appropriately as part of your project legacy. The protocols for access and use of the project data need to be well defined before the project begins. Everyone has their own favorite way to store and handle data. There must be mechanisms for restricting access



The data management system for a large SES project (REACCH) to enable storage, access, integration of data sets. Credit: Erich Seamon

to newly acquired data as well as plans for transitioning data to open access after project termination. Data concerning human subjects will require restrictions consistent with your institutions' Institutional Review Boards and the agencies that have provided access to sensitive datasets. The project director and data management team need to ensure that all participants are aware of the data management plan and requirements of researchers. Many projects require participants to sign off on the plan. The expectations for rigorous data management will only increase during the life of projects now getting underway. Be proactive,

anticipate, and get out in front of the rapidly evolving data management expectations of your funding agency.

Attribution

Credit attribution may be an issue with data being shared and much of the work being done jointly. Although not all projects have found it necessary, consider developing an attribution policy early in the project both for data use and for any of the papers or other products from the research. This can delineate expectations for authorship, citation, and acknowledgement and help avoid misunderstandings as products are developed.

Intellectual property

Your university and the funding agency will have policies regarding intellectual property (IP). Your project should have an intellectual property policy that is consistent with these policies and is acceptable to the members of your team. This is especially true if you have private companies working on your project. It is important that you articulate the IP requirements and policies early in the project such that there are no surprises when new and patentable discoveries are made down the line.

Take Away Messages:

- When preparing your project proposal, design an infrastructure that will enable the project team to be efficient and effective. Establish clear lines of reporting and responsibility and ensure that project participants have the proper resources to complete their work.
 - An excellent project manager who can handle the budgeting and support issues of the project is essential and will free you to manage the scientific work.
 - The project design needs to have a realistic timeline and budget and should include multiple milestones that facilitate annual evaluation and assessment. Baseline data against which progress can be compared will facilitate evaluation. It is essential that expectations on meeting these milestones be communicated to the team. Further, the team must recognize that the project management plan may change in response to new ideas and challenges.
 - A large unifying goal can help the whole team by motivating project researchers and improving morale.
- A data management plan that defines the location, form, and protocols for storing and accessing data must be developed early in the project. This data plan needs to be reviewed annually to make sure it is working for all of the project members to determine if there are technology improvements that better support the data management system.
 - Develop an attribution policy early in the project both for data use and for any of the papers or other products from the research. The attribution policy should delineate requirements for authorship, citation, and acknowledgement.
 - The intellectual property policy should be consistent with the policies established by the lead university and funding agency as well as the institutions project team members are affiliated with.



A flume to set hydrological baselines in wheat fields in the USDA-NIFA sponsored REACCH project. Credit: Erin Brooks