The Amphibious Array Facility: Good and Cheap

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The project management triangle is a graphical means to illustrate the competing constraints of cost, quality and schedule on the implementation of complex projects. Starting with the idealistic desire for an outcome that is "good, fast and cheap", there is a well-known adage that the project manager must first ask the client to "pick two". The Cascadia Initiative came about because of Federal stimulus funding for the infrastructure that forms the Amphibious Array Facility (AAF). This constrained the project to a schedule that was extremely challenging for the offshore seismic component. The execution of the ocean bottom seismometer (OBS) construction and deployments has thus, revolved around the competing demands of cost and quality. Costs per deployment have benefitted from the scale of the experiment but quality has naturally been emphasized because of the community's desire to see good data from such a high-profile experiment and the dedication of the OBS Instrument Pool (OBSIP) personnel.

In comparison with all earlier OBS experiments, the total cost of the CI experiment has been high. It could be argued that the experiment would never have gotten off the ground had these costs and the future NSF Marine Geology and Geophysics science budgets been widely appreciated at the project's outset. There are clearly now budgetary concerns about proceeding with future experiments of a similar magnitude. However, when the size and anticipated impact of the CI experiment are taken into account, a good case can be made that it is very good value for money. The scale of the experiment reduced the costs per instrument-year of data compared with earlier PI-driven experiments. Hundreds of scientists have already accessed the CI data and interesting results are already being presented. If the experiment was now evaluated on acquisition cost per instrument-year of data downloaded or is evaluated in a few years time on the acquisition cost per scientific publication, it is likely to compare favorably with earlier experiments.

Before discounting the fiscal feasibility of redeploying the AAF for a community experiment on a similar scale, it is important to think about how future deployments can be optimally managed. High quality data underpins most seismology, and science budgets will always be oversubscribed. Thus it seems sensible for the science community to expect that future experiments be optimized for price and quality at the expense of taking a little more time, an option that was not available for the CI experiment because of the timing constraints of Stimulus funding. So how might this be accomplished?

The AAF offshore instrumentation comprises four different OBS designs built by three groups that were supplemented by a fifth design for the CI experiment and several more for linked PI-driven experiments on the Blanco Transform and Gorda Plate. This limits economies of scale and for the CI experiment required three mobilizations and cruises for each annual deployment and three more cruises for each annual recovery. One relatively quick fix would be to explore the feasibility of extending the battery life of the current AAF OBSs to 15-18 months. This would not only halve the number of deployments required to collect a given amount of data but would also enable deployments that extended across two summer weather windows and provide the OBS teams with a more leisurely turnaround time, thus contributing to instrument reliability. One drawback of this approach might be the need to explicitly plan for repeat deployments at sites where an OBS malfunctions or is poorly coupled to the seafloor. For the LDEO trawl resistant OBS, an investment should be made in test cruises to determine whether they can be reliably recovered with a compact shallow water remotely operated vehicle (ROV) rather than the using the Jason deep-water ROV. Consideration should be given to the relative costs of using regional vessels that can hold one OBS group versus global vessels that can accommodate at least two.

Looking further ahead, the AAF OBS pool should be enhanced on the basis of a careful examination of the total costs and instrument needs of high-quality experiments. Although OBSs are expensive, their construction costs for the CI experiment were smaller than both the ongoing costs over the 4-year experiment of the OBSIP facility to operate them and the ship time to deploy and recover them. To reduce future costs, efforts should be made to standardize the designs of OBS components that can be manufactured commercially and to configure instruments that can be operated more efficiently at sea. At the same time it needs to be recognized that ongoing OBS engineering efforts are critical for a continued push towards increased data quality and reduced operating costs. Important developments that have either been recently been implemented or discussed include the use of atomic clocks to support improved timing and longer deployments; the implementation of shields to reduce noise and protect instruments from trawling; the use of pressure sensors and tilt meters to remove wave-generated noise in shallow water from vertical and horizontal channels, respectively; the burial of OBS sensors without remotely operated vehicles; the development of lower power requirements and improved battery packs for multi-year deployments; and the extraction of data using autonomous data mules or data pods.

There are a lot of political obstacles to optimizing the OBS component of the AAF for quality and cost including short term institutional self-interest, a resistance to change that seems inherent to academic enterprises and the Balkanizing of funding pots within NSF, but the payoffs to the future of marine seismology are, at least in this author's view, clearly worth the effort.