2005 Implementation Plan
MBARI Platforms Engineering Group

DOCUMENT CONTROL SHEET

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1 Scope

This document comprises the implantation plan for the MBARI Platforms Engineering Group strategic plan. It is to be updated periodically (every year)

2 Implementation Plan

2.1 Current science trends

Here we attempt to identify the science trends and programs that are most relevant to our strategic plan. Through formal and informal interactions with scientists, reading workshop reports, etc. we try to identify the most relevant

- Broad science themes
    - Objectives
    - Specific science research programs
        - Science questions posed
            - Impact on science community/society
            - Experiments proposed/ongoing
                - Measurements
    - Common technology elements with greatest impact

2.1.1 MBARI 10 Year Plan, scientist meetings

- Biology and Chemistry of the Oceans in Relation to the Solid Earth Cycle
    - Develop quantitative, unifying principles that govern subsurface fluid transport and venting, its control or magmatic processes and its influence over the habitat and ecology of benthic communities
    - Characterize underlying linkages between geophysical, geochemical and biological processes
    - Understand the relationships between ground motion, mass wasting, and fluid flow in tectonically and/or volcanically active environments
    - Understand the modifications of fluids by biological processes and the relationship between specific target populations and the local vent/seep environment
    - Quantify major biogeochemical budgets such as greenhouse gases and hydrothermal effluent
- Biology and Chemistry of the Oceans in Relation to Global Change
    - Understand the chemical and energy cycling through the entire food web, from picoplankton up through the top level of predators
        - Benthic Pelagic Coupling
        - Fate and transport of organic carbon
        - Biogeochemical Cycling
        - Low pH Ocean
    - Understand the structure of ecosystems in the upper ocean and the impact of the ecosystem structure on marine biogeochemistry

- Assessment of the role of regional circulation of macro and micronutrients to the euphotic zone
- Identification of the impact of a variable nutrient supply on the community structure throughout the water column (including bacterial processes)
- Distinguishing patterns in community structure and/or succession that derive from episodic events on time scales ranging from days to decades

2.2 Technological limitations to science

- Energy
  - Mobile platforms (e.g., AUVs) can only carry limited payloads due to energy constraints
  - Mobile platforms' operation endurance is limited by on-board energy
- Measurement techniques
  - Measuring number of particles in water
  - No measurement techniques between bulk properties and microscopic assay
  - Difficult to observe and characterize thin layers and other morphologies of water (layers are easiest to find)
  - Chemical sampling time
- Signal detection and classification
  - Robust event detection algorithms (to save energy)
  - Event detection requires many contextual sensors and data sources (satellite)
- Sensor accuracy
  - Sensor drift
- Reliability
  - Biofouling
  - Longevity of platforms/cables/instruments
- Size and scale of ocean vs available observing technology
  - Platform/instrument cost vs coverage
- Telemetry
  - Cost vs bandwidth vs energy of over-the-horizon telemetry (e.g. ARGOS, Iridium)

2.3 Emerging technology

2.4 Developments in instrumentation and software

2.5 Specific opportunities to consider

2.6 Platform development and applications

- AUV docking

- Mapping AUV capabilities: acoustic comms, obstacle avoidance, aided navigation capabilities (LBL, USBL), improve user interfaces, battery issues (full ocean depth), real-time autonomous assessment/adjustment of sonar, autonomous navigation through extreme terrain (canyons), replace deep tow vehicles ($$) for some applications
- Dynamic positioning camera platform
- AUV camera capability
- Fly away ROV capability
- Epipelagic use of ROVs
- Station keeping floats
- Benthic rover
- Platforms that address sensor drift/calibration issues
- "Disposable" easy to deploy observation platforms (profilers, moorings, floats (ARGO))
- Smart materials and structures for new class of platforms and vehicles

2.7 Measurement techniques

- In situ respirometer
- Bioluminescence cell counter

2.8 Telecommunications techniques

- Adapting DSL to oceanographic use
- Ethernet instrumentation infrastructure

2.9 Algorithm/software development and applications

- Event detection and response infrastructure
- 3D scene recreation
- Virtual operating environment for ROV may move ROV's ahead of HOV's for science utility
- Coupling of heterogeneous observation systems to models
- Web services implementations for small embedded platforms

2.10 Anti-biofouling

- Platforms that reduce biofouling/impact
- Reducing the *impact* of biofouling (not necessarily reducing biofouling itself)

2.11 Energy harnessing

- In situ energy harvesting for platforms and vehicles (wave energy, seawater and bio batteries)
- High efficiency power distribution on seafloor (and power conversion)

- Coupling of heterogeneous observation systems to models
- Reducing the *impact* of biofouling (not necessarily reducing biofouling itself)

2.12 What are the key strategic objectives of the next 1-2 years?

2.12.1 Develop infrastructure and opportunities to support periodic and unscheduled interactions between engineers and scientists

2.12.2 Work with science, instrument and software groups to establish set of favored developments and collaborations to pursue

2.12.3 Influence proposal development for 2005 to integrate science/engineering interactions and phased science payoff milestones

2.12.4 Review and endorse/comment on relevant 2005 MBARI proposals

2.12.5 Conduct a joint engineering and science review of technology initiatives (cold washup) at MBARI

- To identify specific elements that make a technology effort a success or failure from engineering or science perspectives
- Examine how projects did or did not reach the science tipping point

2.12.6 Perform a rigorous technology survey covering

- fundamental technologies
- emergent/disruptive technologies
- oceanographic technology trends
- trends in other industries/fields

2.12.7 Create education/training opportunities for engineers to build science knowledge

2.13 Opportunity selection process

2.14 Specific strategic opportunities and collaborations we will develop (and rationale)

2.15 What interfaces, mechanisms and tools will we provide to our stakeholders to communicate with us?

- Meetings
- Procedures
- Reports
- Workshops
- Web site/blogs/mail lists

- Standards