

U.S. IOOS Ocean Technology Transition Project

Advancing technology through the transition of ocean, coastal, and marine sensors and platforms to operations

MISSION

The IOOS Ocean Technology Transition project sponsors the transition of emerging marine observing technologies, for which there is an existing operational requirement and a demonstrated commitment to integration and use by the ocean observing community, to operational mode.

VISION

Transitioning marine observing technology to operations will result in improved ocean, coastal, and Great Lakes observing capabilities that are critical for helping us understand our ocean, coastal, and marine environments and improve environmental intelligence for environmental decision making.

Executive Summary

The primary objective of the U.S. Integrated Ocean Observing System’s (IOOS) Ocean Technology Transition Project is to reduce the Research to Operations transition period, commonly referred to as the “Valley of Death”, for ocean observing technologies. This is accomplished by investing in the transition of emerging and promising marine observing technologies from the mid- to latter phases of research into operational status.

The Ocean Technology Transition Project was launched by IOOS in 2013. The Project focuses on developing and improving observation technologies for ocean chemical, biological, and physical parameters at multiple spatial and temporal scales to monitor changing conditions in the oceans, coasts and Great Lakes. Marine observation technologies include hardware and software platforms, sensors, and data transfer technologies that collect observations in the marine and Great Lakes environments.

This document describes the process the Ocean Technology Transition Project utilizes to accomplish its mission to advance the transition of marine observing technologies into operations, which is based on analysis of similar technology transfer programs in other organizations, such as the Joint Capability Technology Demonstration (JCTD) program at the Department of Defense. Key elements of the various sampled programs were adopted and/or adapted to meet the particular needs of the IOOS community.

Introduction and Background

The United States' Integrated Ocean Observing System (IOOS) is a National and Regional partnership working to provide new tools and forecasts to improve safety, enhance the economy, and protect our environment. IOOS consists of contributions from Federal and non-Federal assets and capabilities to advance the utility of marine observations by creating systems to rapidly and systematically acquire and disseminate ocean, coastal, and Great Lakes data and data products to meet critical societal needs. Currently, there are 17 Federal organizations^A and 11 Regional Associations^B (RAs) registered as partners in the IOOS. A complete list of the national and regional partners can be found in the Reference Section of this document; the IOOS website is: www.ioos.noaa.gov.

The IOOS Ocean Technology Transition (OTT) Project was launched by the U.S. IOOS Office in 2013 as a centralized and coordinated approach to facilitate an effective structure for resourcing the transition of marine observing technologies to operational status in support of priority ocean observation programs. IOOS was directed by the Integrated Coastal and Ocean Observing System Act of 2009 to 'develop a plan to efficiently integrate into the System new, innovative, or emerging technologies that have been demonstrated to be useful to the System and which will fulfill the purposes of this subtitle and the System Plan' [Sec. 12304(3)(M)]. The process outlined in this document describes the approach utilized by the OTT project to accomplish this objective. The process emphasizes coordination within IOOS partners' technology offices, budgeting shops, and operational units.

OTT's mission is to accelerate the transition of viable systems from research to operational monitoring of coastal and oceanic regions. Operational mode is defined as the actual application of the technology in its final form and under mission operations. OTT focuses on developing and improving observation technologies for ocean chemical, biological, and physical parameters at multiple spatial and temporal scales to monitor changing conditions in the oceans, coasts, and Great Lakes. Marine observation technologies include hardware and software platforms, sensors, and data transfer technologies that collect observations in the ocean, marine, and Great Lakes' environments.

To execute its mission, OTT sponsors the transition of emerging and promising marine observing technologies, for which there is an existing operational requirement and a demonstrated commitment to integration and use by the ocean observing community, to operational mode. Project resources are targeted to marine observing systems that are beyond their research phase, with specific emphasis on transitional and lifecycle costs, including data management, overall operations, and maintenance expenses. Partners involved in the project since its inception include federal agencies, academia, and private sector organizations, such as Satlantic, WET Labs, Spyglass Technologies, Inc., and MBARI.

Ocean Technology Transition Approach

Overview

The IOOS Ocean Technology Transition Project (OTT) is an ongoing, multi-year effort to transition prototype marine observing technologies to operations in a stepped, parallel, and scalable process that includes stakeholder engagement from industry, government, academia and others invested in the monitoring and assessment of the nation's ocean and coastal regions. For the purposes of this document, marine observation technologies include hardware and software platforms, sensors, and data transfer technologies that collect observations in the ocean, marine, and Great Lakes' environments.

OTT utilizes the Technology Readiness Levels (TRLs) ontology, which were introduced by NASA in 1995^c. The TRL is used as a systematic metric/measurement system that supports assessments of the maturity of a particular marine observing technology, and enables a consistent comparison between different types of technologies.

Typically, research funding announcements from agencies such as the NSF are for concepts and devices in the TRL 1 to TRL 5 range, which are areas specifically not addressed by OTT. OTT specifically focuses on transitioning marine observing technology from TRL 6 to TRL 9 as shown in the right of Figure 1; in effect transforming the innovative research developed *externally from this Project* into operational devices and sensors for IOOS partners.

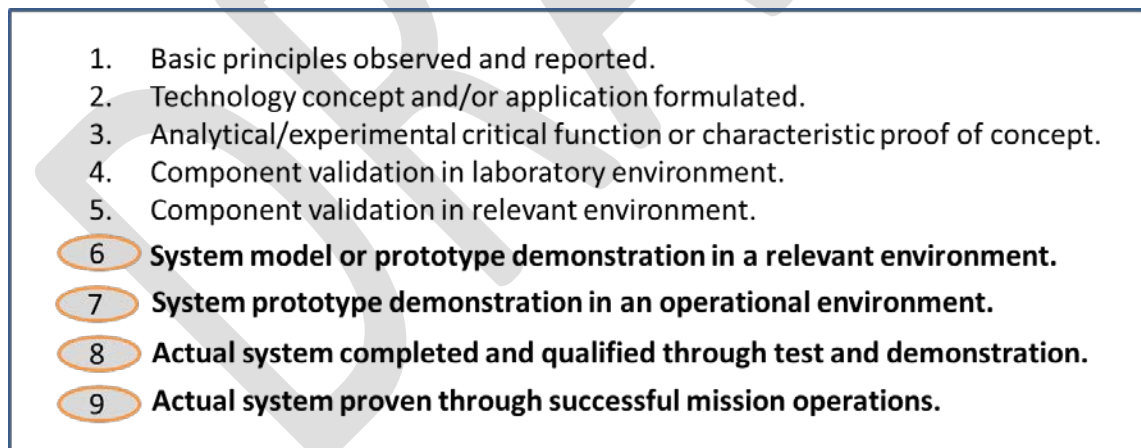
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1. Basic principles observed and reported.
 2. Technology concept and/or application formulated.
 3. Analytical/experimental critical function or characteristic proof of concept.
 4. Component validation in laboratory environment.
 5. Component validation in relevant environment.
 6. **System model or prototype demonstration in a relevant environment.**
 7. **System prototype demonstration in an operational environment.**
 8. **Actual system completed and qualified through test and demonstration.**
 9. **Actual system proven through successful mission operations.**

Figure 1: An Overview of TRL Values

Individual TRLs shown by red ovals labeled 6, 7, 8, and 9 in Figure 1 indicate further stages of technology maturation, with TRL 9 considered "Operational." Moving from TRL 6 to TRL 9 is the challenging area commonly referred to as the Research to Operations' "Valley of Death". OTT was established by IOOS to advance marine observing technologies within TRL levels 6-8 to TRL 9 thus providing a 'Valley of Opportunity'^d for proven marine technologies to transition to operational mode.

Identifying and Obtaining Ocean Technology Transition Project Sponsors

To successfully transition marine observing technology to operational mode, OTT identifies and obtains in writing operational sponsors with intent to support the long-term operational and maintenance costs of advanced marine observing technology deployment, operations, and data distribution. By design, no proposed OTT project funding will be used to operate any marine observing technology in operational mode. IOOS funding for each transition project is limited to a specific period of time (variable for each technology, but not to exceed five years). Additionally, all funding is focused on transitioning TRL 6-8 prototypes into TRL 9 (proven) systems. In this process, OTT uses NOAA's mechanism for transition uses NOAA Administrative Order^H (NAO) 216-105 "Policy on Transition of Research to Application" to describe its transition of technology from Research to Operations (Appendix 1).

IOOS funding for OTT projects in FY14 was \$3M, but funding is scalable to coincide with appropriated funding levels. There is a minimum base cost/level-of-effort to transition just one prototype. Funding for each individual OTT project terminates as it transitions to the operational sponsor at the scheduled date (project dependent). The continued operational expense would then be picked up by the original sponsoring agency, as per the written agreement previously arranged. *There is no operational expense tail for IOOS with OTT.*

References

A. IOOS Federal Partner List:

1. National Oceanic and Atmospheric Administration (NOAA)
2. National Science Foundation (NSF)
3. National Aeronautic and Space Administration (NASA)
4. Environmental Protection Agency (EPA)
5. Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE)
6. Marine Mammal Commission (MMC)
7. Office of Naval Research (ONR)
8. Oceanographer of the Navy, representing the Joint Chiefs of Staff (JCS)
9. U.S. Army Corps of Engineers (USACE)
10. U.S. Coast Guard (USCG)
11. U.S. Geological Survey (USGS)
12. Department of Agriculture, Cooperative State Research, Education, and Extension Service (CSREES)
13. Department of Energy (DOE)
14. Department of State (DOS)
15. Department of Transportation (DOT)
16. Food and Drug Administration (FDA)
17. U.S. Arctic Research Commission (USARC)

B. IOOS Regional Associations List:

1. Alaska Ocean Observing System (AOOS)
2. Caribbean Regional Association (CaRA)
3. Central and Northern California Ocean Observing System (CeNCOOS)
4. Gulf of Mexico Coastal Ocean Observing System (GCOOS)
5. Great Lakes Observing System (GLOS)
6. Mid-Atlantic Coastal Ocean Observing Regional Association (MARACOOS)
7. Northwest Association of Networked Ocean Observing Systems (NANOOS)
8. Northeastern Regional Association of Coastal and Ocean Observing Systems (NERACOOS)
9. Pacific Regional Integrated Ocean Observing System (PacIOOS)
10. Southern California Coastal Ocean Observing System (SCCOOS)
11. Southeast Coastal Ocean Observing Regional Association (SECOORA)

C. Technology Readiness Levels

www.smdc.army.mil/Contracts/BAA/DoD-TechnologyReadinessLevels.doc

<http://www.hq.nasa.gov/office/codeq/trl/trl.pdf>

- D. Merceret, F. J., T. P. O'Brien, W. P. Roeder, L. L. Huddleston, W. H. Bauman III, and G. J. Jedlovec (2013), Transitioning Research to Operations: Transforming the "Valley of Death" Into a "Valley of Opportunity", *SpaceWeather*, 11, 637–640, doi:10.1002/swe.20099.

DRAFT

Appendix 1: NOAA Administrative Order 216-105

NAO 216-105

Eff: 7/24/08; Iss: 7/31/08

POLICY ON TRANSITION OF RESEARCH TO APPLICATION

SECTION 1. PURPOSE AND SCOPE.

.01 Application of the best available science and technology is essential to meeting the National Oceanic and Atmospheric Administration's (NOAA) mission. This demands an operations enterprise that is able to quickly recognize and apply significant new research products and methods; a research and development enterprise focused on the ultimate application of emerging science and technology to user needs; and a formalized management structure that ensures that both the research and development enterprise encourage and support the transfer of research to operational status or information services to meet mission responsibilities.

.02 This policy establishes the process for identifying and transitioning research results to applications. The policy outlines the roles and responsibilities of various officials, including Line Office Transition Managers, associated with the transition of research results to applications. Additionally, the policy identifies those entities that have the authority to implement this policy and those who are accountable for transitioning research results to applications.

.03 The policy applies to all NOAA research results, whether conducted in house or externally, and to relevant research sponsored by others. The policy recognizes that NOAA research provides:

- a. capabilities (e.g., tools, systems, techniques, and procedures) suitable for transfer to operational status within and external to NOAA; and
- b. information services provided directly to internal or external users.

.04 This policy does not apply to the prosecution of patents by NOAA or its employees for inventions made in the course of research, or to the licensing of government owned inventions in the custody of NOAA. Such matters are addressed by other applicable laws, regulations, and policies.

SECTION 2. DEFINITIONS.

.01 Application: The use of research results in furthering NOAA's mission.

.02 Defined Criteria: Technical performance and cost-effectiveness parameters to be met prior to the operational implementation or information service delivery.

.03 Information Services: Production and delivery of interpreted and/or synthesized data, decision tools, and scientific knowledge and understanding to decision and policy makers, the scientific community, and the public.

.04 Operations: Sustained, systematic, reliable, and robust mission activities with an institutional commitment to deliver specified products and services.

.05 PPBES: The Planning, Programming, Budgeting, and Execution System (PPBES) is the process used to link NOAA's strategic vision with programmatic detail, budget development, and annual operating plans. A major decision-making process, the PPBES requires the Line Offices, Goals, and Programs to do joint planning and link directly to NOAA's Programming, Budgeting, and Execution phases.

.06 Research: Systematic study directed toward a more complete scientific knowledge or understanding of the subject studied.

.07 Test Environment: Collection of hardware, software, staff, funding, and/or appropriate procedures to simulate an operational setting in order to facilitate the demonstration and evaluation of research results.

.08 Testbed and similar Development Systems: A representation of a system consisting of hardware and software, plus computer simulation models, or prototype hardware and software, on which one can perform test and evaluation of any process, product, or software. These are continuous processes by which numerous incremental improvements are planned and implemented for a system consisting of both hardware and software. These processes result in the aggregate planning of improvements and development plus the subsequent reporting of progress on the planned aggregate and specific outcomes, as appropriate.

.09 Transition Plan: A management document, which should be updated as appropriate, identifying the comprehensive activities necessary to transfer a research result to applications. This document should be used for planning purposes as well as to ensure that the project is being executed per the terms and conditions of the Plan. The Transition Plan shall:

- a. clearly define the requirements of the end-result of the transition of research to applications;
- b. define data collection requirements and procedures in sufficient detail to enable the applications organization to understand and meet, as appropriate, the data requirements of the research organization and other users;

- c. document technical performance and cost-effectiveness parameters to be met prior to the operational implementation or information service delivery;
- d. justify the transition from the research to applications and document how the benefits outweigh the costs;
- e. identify the amount and source of funds needed to cover the costs associated with the transition, as necessary, including relevant requirements for equipment, upgrades, staff training, and maintenance of redundant application capabilities during the transition period;
- f. outline how the applications organization will address the evolving needs of the research organization, partners, and users after the transition, as appropriate; and
- g. for testbeds and other similar development systems/projects, the transition plan is a compilation of numerous individual project components whose net result is a significant improvement or advancement in NOAA capability justified, in general, using the elements defined above.

.10 Transition Project: The collective set of activities necessary to transfer a research result, or collection of research results, to operational status or to an information service, examples include the installation of a new weather radar, improvements to existing systems (i.e. AWIPS), installation of a ground system upgrade or placement of a research buoy (or buoy system) into operations. The NOAA Program Managers and Goal leads shall ensure that their planning products address all costs for these projects. This shall include transition activities such as consideration for continuing research, production development and commencement of operations, as appropriate. Development or Testbed Programs are an ongoing effort to incrementally improve NOAA capability in a specific domain where an individual(s) or oversight body can be assigned the responsibility for setting priorities, planning, implementing, and achieving specific outcomes and are not considered transition projects.

.11 Line Office Transition Managers: The Line Office Manager who is responsible for managing the Line Office transition of research to application portfolio of projects.

.12 Transition Project Lead: One individual responsible and accountable for ensuring that the transition project is planned, programmed, budgeted, and executed per the Transition Plan. For testbeds and other similar development projects, it can be either a person (e.g. the testbed lead) or an identified group of people who will be responsible for the transition plan, progress reports, and the project outcomes.

.13 Transition Project Team: A group of individuals, representing the research and applications communities, who support the transition project lead and are assigned the responsibility to execute the project per the terms and conditions of the agreed upon Transition Plan.

SECTION 3. POLICY.

.01 In order to meet mission needs, NOAA will maximize the timely application of NOAA sponsored research and capitalize on non-NOAA research. To fulfill this goal, NOAA shall maintain:

- a. an operations enterprise capable of quickly identifying and applying proven research results to provide new and improved services or more efficient operations while continuing to maintain reliable, cost-effective services for users;
- b. a research enterprise that routinely provides proven research results to serve NOAA's mission while adapting its portfolio to address new research frontiers; and
- c. planning and oversight processes to include routine identification of new opportunities/needs for research, development of Transition Plans, status reporting, and test and evaluation procedures.

.02 NOAA's PPBES provides the framework for identifying and executing transition projects; which includes both finite projects/programs and continuous processes like the testbeds and similar development systems/capabilities. During the annual PPBES cycle, all research activities shall be reviewed to ensure activities are responsive to mission requirements and to identify research results ready to be transferred to operational status or delivered as an information service. PPBES documentation shall reflect end-to-end resources and associated performance measures for all transition projects.

a. **Transition Planning:** The Planning phase of the PPBES identifies what should be done within the NOAA Program to achieve NOAA's strategic goals, objectives, and annual priorities. Line Office Transition Managers and Transition Project Leads shall work with NOAA Program Managers and Goals to ensure inclusion of transition projects in appropriate Planning documents. The NOAA Program Managers and Goal leads shall ensure that their Planning products address research funding as well as the associated transition costs. During the Planning phase both the research and operational entities shall agree to the timeliness, feasibility, and compatibility of the transition with operational environments. Where appropriate, both the research and operational communities shall work together and discuss transition opportunities when planning new research projects. Additionally, the NOAA Research Council shall review pertinent Planning documentation and ensure that research is appropriately planned to include transitioning to applications.

b. **Transition Programming:** The Programming phase in PPBES entails analyses of the Planning phase products and the development of a fiscally-balanced NOAA Program. Goals, Line Office Transition Managers, and Transition Project Leads shall work together to ensure that priority transition projects are included in Programming documentation and that funding required is included in the NOAA Program.

c. **Transition Budgeting:** The Budgeting phase in the PPBES builds on the NOAA Program to include the detailed resources requests that will be included in NOAA's annual budget submission and develops

justifications documents to support NOAA's segment of the President's request. Line Office Transition Managers, Line Office Budget entities, and Goal Leads shall ensure that the resources needed to transition research results to applications are appropriately addressed and included in the NOAA Budget submission.

d. Transition Execution and Status Reporting: The Execution phase in the PPBES is critical to ensuring that NOAA satisfies assigned statutory and regulatory duties and delivers the products and services that have been budgeted and appropriated. The Line Office Transition Managers and Transition Project Leads are responsible for ensuring that transition projects are executed as planned. Line Offices shall conduct periodic reviews to ensure that transition projects are being executed as planned. Additionally, Line Offices shall include transition project milestones in their Annual Operating Plans as well as provide the NOAA Executive Panel (NEP) with a bi-annual execution report out on their transition project milestones and status. Should there be a need to arbitrate the terms and specific details of a transition project, the Line Office chain of command should be utilized.

.03 The transition of research results to applications shall be conducted jointly by research and applications personnel.

.04 Transition Plans shall be approved by the Assistant Administrator(s), or their designees, from the impacted Line Office(s). The NEP reserves the authority to approve any Transition Plan.

.05 Final approvals regarding the transition of research to applications shall be based on satisfaction of the defined criteria documented in a Transition Plan.

.06 This Order supports the policies and procedures contained in the Paperwork Reduction Act, the Government Paperwork Elimination Act, the Federal Technology Transfer Act, the Bayh-Dole Act, Office of Management and Budget Circular No. A-130, Management of Federal Information Resources, the NOAA Information Quality Guidelines, and other relevant laws, regulations, and policies. These authoritative requirements apply government resources to activities in support of the agency's mission, outline procedures to ensure and maximize the quality, utility, and integrity of resultant information, and seek to maximize the benefits of resultant information and intellectual property to society.

.07 NOAA shall be cognizant of and observe the valid rights of patent holders and owners of other intellectual property.

SECTION 4. RESPONSIBILITIES.

.01 The Under Secretary of Commerce for Oceans and Atmosphere (NOAA Administrator), the Assistant Secretary, and the Deputy Under Secretary shall provide top management support for implementation of this policy and the development and implementation of associated procedures.

.02 The Assistant Administrator, Office of Program Planning and Integration, the Director, Program Analysis and Evaluation, and the NOAA Chief Financial Officer are responsible for management of the Planning, Programming, and Budget phases of PPBES, including activities necessary to support the implementation of this policy.

.03 Line Office Assistant Administrators and the Director, Office of Marine and Aviation Operations, are responsible for the following:

- a. promoting the goals and implementing the requirements of this policy;
- b. approving Transition Plans;
- c. providing staff support for the appropriate Transition Teams;
- d. providing oversight for all projects in their Line Office;
- e. ensuring a Line Office quarterly transition project review is conducted;
- f. approving final decisions regarding the transition of research results; and
- e. reporting on the execution status of transition projects per instructions provided by the Deputy Under Secretary for Oceans and Atmosphere.

.04 Line Office Transition Managers are responsible for the following:

- a. managing the Line Office transition portfolio;
- b. fostering applicable Line Office transition projects through PPBES;
- c. tracking and providing timely reports to Line Office leadership on the status of the portfolio;
- d. ensuring the development of appropriate Transition Plans; and
- e. coordinating with other Line Office(s) Transition Managers, Program Managers, and Goal Teams when appropriate.

.05 Transition Project Leads are responsible for the following:

- a. managing the transition project and all associated activities;
- b. leading the transition team;

c. working with the Line Office Transition Managers to foster their transition projects through the PPBES processes; and

d. ensuring the development of appropriate Transition Plans.

.06 Transition Teams will include representatives from the research and applications communities.

Transition Teams are responsible for the following:

a. preparing Transition Plans;

b. conducting transition activities; and

c. identifying, reporting, and responding to significant deviations in the execution of the Transition Plan.

.07 Mission Goal and Sub-goal Leads are responsible for the following:

a. identifying and planning for transition of research results with appropriate Program Managers and Transition Leads;

b. working with Line Office management, specifically Line Office Transition Managers, to ensure Transition Plans for projects within their Goals are developed;

c. seeking relevant external research results and projects in conjunction with Program Managers and the NOAA Research Council; and

d. coordinating activities between research and operational programs as needed.

.08 Program Managers for programs including research are responsible for the following:

a. proposing and planning for priority research projects;

b. identifying and planning for transition of research results into applications; and

c. developing research responsive to agency mission requirements: (1) through understanding and anticipating user needs; (2) through maintaining cognizance of operational procedures and practices; (3) through exploring relevant new and emerging science and technology internal and external to NOAA; and (4) through supporting peer reviewed science.

.09 Program Managers for programs including operational and other regulatory activities are responsible for the following:

a. planning for the transition of research results;

- b. understanding and meeting user needs;
- c. identifying operational requirements;
- d. maintaining cognizance of on-going research projects and results;
- e. fostering opportunities for new research including introducing new operational practices or procedures; and
- f. establishing and maintaining dialogue with researchers.

.10 The NOAA Research Council is responsible for the following:

- a. participating in the PPBES process and providing comments regarding the research portfolio which includes identifying the readiness of research results to transfer and the relative priority of these projects;
- b. overseeing NOAA activities to identify applicable external research results; and
- c. ensuring the NOAA 5-year Research Plan identifies and plans for research results to be transitioned to applications.

.11 Other applicable Councils are responsible for participating in the PPBES process and providing comments regarding the identification and readiness of projects for transfer and the relative priority of these projects.

SECTION 5. EFFECT ON OTHER ISSUANCES.

This Order supersedes NOAA Administrative Order 216-105 dated May 17, 2005.

/Signed/

Under Secretary of Commerce for
Oceans and Atmosphere

Office of Primary Interest:
Program Planning and Integration