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White Paper: No Transitions? No Outcomes!

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Executive Summary

Transitioning research to applications (R2A) is a challenge for many Federal agencies and the National Oceanic and Atmospheric Administration (NOAA) is no exception. In order to surmount this “valley of death”, NOAA developed and implemented Administrative Order (NAO) 216-105 in 2005, creating a formal policy on identifying and transitioning research results to application. In the true spirit of adaptive management, NOAA learned from the first generation of the NAO and revised the approach to R2A in the revised 2008 version. After several years of operating within the structure of version 2, the Line Office Transition Managers (LOTM’s) decided it was time to review the progress to date and identify potential ways to enhance NOAA’s R2A efforts. The Line Office Transition Managers formed a transition team (hereafter called “the Team”) to examine the issue. This white paper, and accompanying briefing (accessible at <http://www.nws.noaa.gov/mdl/RITT/>), is the product from the Team, delivered to the LOTM’s on January 12, 2011.

The Team recommends the following engagement by the LOTMs that will help NOAA overcome the “valley of death” existing between research and operations/applications:

- (1) Engage in Strategy, Execution, and Evaluation (SEE) process
- (2) Update NAO 216-105 and implementation procedures
- (3) Explore the LOTMS becoming a subcommittee of the NOAA Research Council
- (4) Report annually to NOAA Administrator
- (5) Interact with Congress to highlight need for R2A funding support
- (6) Publicize outcomes, outputs, and results
- (7) LOTMs, as an entity, “own” and champion R2A
- (8) Request independent peer review of progress
- (9) Explore R2A Federal Advisory Committee Act (FACA)
- (10) LOTMs “own” Ecological Forecast System development.

Since the sunset of the NOAA Transition Board in 2008, LOTM activities have improved R2A. Specifically, cross-LO communication/cooperation has increased, resulting in raised awareness of R2A issues and the triaging of individual projects. However, more work is needed. Inadequate funding, accountability, and incentives still exist, hindering transition. Information on R2A projects and their associated documents, even the successful projects, is frequently incomplete and difficult to find. From a policy perspective, the NAO 216-105 is out-of-date and

applied in bits and pieces. A high priority recommendation is for the NAO to be revised to increased accountability to ensure the Line Offices adhere to the policy.

The Team found that particular difficulties exist when transitions involve two or more NOAA Line Offices (LO). These difficulties exist because of the lack of corporate strategic support for transitioning research to applications in order to create and sustain superior science, service, and stewardship performance. While many types of translational research are underway, they are not easily identifiable, few have consistent performance measures, and they display an assortment of different processes, cultures, missions, and budget lines. Difficulties also exist when the transition occurs to partners and users outside of NOAA (e.g., transition to federal, state, local or tribal agencies or private entities such as academia or industry). NOAA is evolving from being primarily a science-based and discipline-focused organization with service, stewardship, and legislative responsibilities to an outcome-oriented agency. The result of this evolution is the convergence of multiple disciplines and NOAA targeting most, if not all, research and development to meet mission critical responsibilities to protect people, property, ecosystems, and the promotion of economic well-being. Harnessing the convergence of integrated environmental science, service, and stewardship was most recently tested in our response to Deepwater Horizon (2010). Whether it is the transition of recovery plans for species or stock assessments to overfishing applications, or the improvement to storm surge and inundation forecasts, the value chain from research to application needs to be strengthened. To examine the issues, challenges, and opportunities, the Team focused on ecological forecasting, an emerging capability for NOAA that requires multiple Line Office collaboration and cooperation, and consequently an improved R2A process to bring its components together to achieve the desired outcome. To improve this type of transition, the Team recommends the LOTMs solicit the NOAA Executive Panel (NEP) to adopt a proposed resolution on moving forward with an Ecological Forecasting System.

As the title of this white paper states emphatically, achieving outcomes depends upon effectively transitioning research to applications. Across NOAA at the corporate and office level, it is evident that R2A activities lack the recognition, end-to-end planning of R&D, accountability and funding necessary to take full advantage of its R2A portfolio. Each of these items is intimately related. If R2A importance is recognized, then commitment follows and the other factors fall into place.

I. Introduction

Transitions from research to applications (R2A) historically are a challenge for Federal agencies including the National Oceanic and Atmospheric Administration (NOAA). Terms like the “valley of death” portray a seemingly insurmountable challenge of transitioning mature research into an application, either into an operational setting such as a National Weather Service forecast, or a fisheries stock assessment. Particular difficulties exist when transitions occur between two or more NOAA Line Offices (LO), with their different processes, cultures, missions, and budget lines. Difficulties also exist when the transition occurs outside of NOAA (e.g., transition to federal, state, local or tribal agencies or entities such as not-for-profit or commercial enterprises).

Since the early 2000s, commencing with the formation of the NOAA Transition Board, the R2A transition process has gained increased attention, having been perceived as needing improvement. The NOAA Transition Board (2004-2008) provided oversight to NOAA transition projects, with quarterly data calls on progress and updates to transition plans. In addition, the Board drafted the NAO 215-106 “*Policy on Transitioning Research to Application*” that was first enacted in 2005, and updated in 2008. As part of the 2008 NAO update, LOTMs were named for each LO to properly manage the execution of the NAO. The implementation procedures to NAO 215-106, also updated in 2008, provided the details of how to follow the NAO.

Soon after the disbanding of the NOAA Transition Board, the LOTMs deemed it necessary to meet monthly to discuss transition issues. It became evident toward the end of 2009 that the R2A processes in place did not work well and that more needed to be done. At the December 3, 2009, LOTM meeting, a transition “tiger team” [henceforth called the Team] was proposed with a stated purpose to “provide suggestions for furthering NOAA’s approach to transitioning R2A”. The terms of reference were approved by the LOTMs in July, 2010. This white paper, and accompanying briefing material (accessible at <http://www.nws.noaa.gov/mdl/RITT/>), are the result of this effort.

II. Approach

The Team was given guidance not to “reinvent the wheel” or to provide solutions that were “budget based” but instead to look for efficiencies in the current way that corporate NOAA conducts transitions. Along these lines, the team relied heavily on previous NOAA efforts on this topic which have contributed valuable information and recommendations for improving R2A (e.g., the Ocean Research and Resources Advisory Panel (ORRAP) R2A Task Force (2007), Marr and Van Kuren (2008), and Knight and Berchoff (2009)). These presentations can be found at the following web site: <http://www.nws.noaa.gov/mdl/RITT/>. The Team did not conduct surveys but instead reviewed available information germane to the topic of R2A transitions and relied upon the experiences and general knowledge of the team members themselves. The experiences of the team included 3 members who were members of the NOAA Transition Board Working Group -- staffers supporting the board members as well as staffers now supporting the LOTMs.

The Team examined two transition projects (GPS-Met and Ecological Forecasts) as case studies to identify successful strategies, roadblocks to transition, best practices, and solutions to overcome obstacles. GPS-Met, a mature water vapor observation capability from the Office of Oceanic and Atmospheric Research (OAR) has been unable to transition into operations at NWS for many years. The main reason has been insufficient funding resources for the transition and operations and maintenance after transition. But there are other reasons, such as unclear definitions of roles and responsibilities, and inconsistent management support due to change in management and office priorities over the years. Harmful algal bloom (HAB) forecasts in the eastern Gulf of Mexico were successfully transitioned to operations within the National Ocean Service, but challenges remain in expanding the original HAB forecast capabilities to other areas of the Gulf of Mexico and Atlantic/Pacific Oceans and in adding other ecological forecasts (e.g. likelihood of water-borne pathogens) to NOAA’s portfolio.

The Team did not view the transition process in a vacuum, but recognized that the NOAA business environment was evolving, and that any recommendation for change must account for this evolution (e.g., Strategy, Execution, and Evaluation-SEE-process). Three main assumptions were made: (1) NOAA is becoming more “outcome-oriented”; (2) in the short-term, the agency must prepare for flat budgets at best; and (3) the transition of emerging services in support of NOAA’s mission, such as ecological forecasts, represents an increased challenge because of the need for multi-LO transition.

NOAA is evolving from primarily a science-based organization with service, stewardship, and legislative responsibilities to a more outcome oriented agency, linking most, if not all, of NOAA’s research to NOAA’s responsibilities to protect people, property, and ecosystems. Achieving these responsibilities requires transitioning research to applications.

With the assumption of flat (or even decreasing) funding levels for the foreseeable future, new initiatives will likely come from base funds. This is particularly relevant for the operational organizations, which must be willing to terminate outdated legacy products and services to accommodate new transition projects presently in the R2A pipeline.

The Team focused on identifying R2A challenges for emerging forecasts such as HABs and other ecological forecasts that span engagement from multiple, if not all, Line Offices within NOAA.

The Team was tasked to answer 5 questions, as defined in the Terms of Reference:

- (1) *What is the status of NOAA's efforts to address transitioning research to applications (e.g., NAO, Line Office Transition Managers, etc)?*
- (2) *Is NOAA's current approach to transitioning research to applications accomplishing its goal?*
- (3) *What research has been transitioned to applications recently?*
- (4) *What research might be transitioned in the next 5 years?*
- (5) *What are the best procedures, approaches, and capabilities that NOAA can employ to provide the best chance of success?*

III. What is the status of NOAA’s R2A efforts?

The seminal policy document for R2A efforts is the NAO 216-105 “*Policy on Transition of Research to Application*”, originally enacted in 2005 and last updated in July, 2008. In the latest version, responsibility for overseeing R2A was moved from the NOAA Transition Board to the LOTMs. The policy, among other things, intersects with strategic planning, requires formal transition plans, identifies responsible parties, and includes an implementation procedures document that provides additional detail on how to execute the policies.

However, the Team identified numerous shortcomings of the NAO as well as inadequacy of its execution. These shortcomings include the following. The NAO:

- (1) Does not address evaluation of transitions relative to outcomes;
- (2) Is necessary but not sufficient to successfully transition a project;
- (3) Does not address the need for corporate-NOAA support ;
- (4) Does not call for a NOAA-wide repository of transition activities and information;
- (5) Does not provide consistent guidance on how R2A activities and results are applied, documented, or accessible.

IV. Is NOAA's R2A approach accomplishing its goals?

The Team was unable to ascertain if the R2A approach was accomplishing its goals at a NOAA corporate level. Nevertheless, symptoms were evident for a weak value-chain from research to application impacting programs, projects, and activities at multiple levels and scales. Without a common concept for transition goals, outcomes, outputs, and performance measures, the Team could not quantify accomplishments. With some considerable effort, information on some transition projects and activities was found. In many cases this information or knowledge is held in separate LOs, or distributed across centers and groups throughout NOAA. When available, this information is captured in different formats using different process and it is uncertain if this information adequately accounts for most of the R2A investments in NOAA. Clearly, the existing NAO, LOTM efforts, and individual projects have not fulfilled corporate R2A goals and performance measures. Without readily accessible transition plans, evaluation of the strategic importance of transition projects, and readily identifiable “success” stories, the Team could not answer the question.

Since October of 2009, when the LOTMs were handed the R2A responsibilities of the Transition Board, their activities have primarily focused on near-term issues instead of longer-term (~3 to 5 years) planning and portfolio prioritization. There are signs of improvement and a few promising developments since the NOAA Transition Board was superseded by the LOTMs. By meeting every month, the LOTMs have increased cross-LO communication/ collaboration at a working level. Also, the awareness of the importance of R2A has increased, with R2A-relevant language inserted into the NOAA Next-Generation Strategic Plan (2010) and the Annual Guidance Memorandum for FY11. At the monthly meetings, individual projects have been triaged and letters of agreement have been created between LOs and have become a good mechanism to formalize LO commitments toward specific research to application efforts. A potential model is the NCEP-NOS letter of agreement (*A National Backbone for Operational Hydrodynamic Modeling from the Ocean to Coastal Waters*). However, no measurement of research transitions to outcomes currently exists (leading to the axiom: if it doesn't get measured, it doesn't get done). And, without a formal NOAA requirements process, there appears to be no corporate approach (i.e., requirements are defined either by researchers, or operations, but often not together).

V. What research has been transitioned recently?

Continuing with the theme from question #2, recent transitions from research to application are not readily identifiable. There is also no organized process within NOAA to collect, and publicize R2A successes. This oversight is consistent with the fact that awards are seldom given for successfully transitioning research into applications or operations. Instead, scientists are recognized for the scientific advancement achieved, regardless of whether transition occurs or not.

Some successes were identified from the NWS R&D portfolio and the Operations and Services Improvement Process (OSIP) database and individual LO annual operating plans. Recent successful transitions include:

- *Meteorological Assimilation Data Ingest System (MADIS) initial operating capability (FY09)*
- *Great Lakes Wave Modeling (FY09)*
- *Great Lakes Observing System (FY09)*
- *Great Lakes Operational Forecast System (FY10)*
- *Operational Harmful Algal Bloom (HAB) forecasts expanded from West Coast of Florida to Texas (FY10)*

VI. What were the characteristics of R2A that enabled success?

The Team identified commonalities among successful transition projects and concluded that there are three critical characteristics for success: (1) strategic planning is linked to budgets and vice versa; (2) accountability for results and management oversight is clearly defined; and (3) transition tools and performance metrics are utilized. Each of these three characteristics that enable success, requires a collection of efforts identified below.

To link strategic planning together with the budget, there must be a transparent process for first defining NOAA requirements, and then prioritizing and tracking research projects. Throughout the research project, technical readiness levels (TRL) should be used to measure the maturity of the science. As projects move from idea to working prototype, projects are validated as “transition” projects in a push-pull dynamic (i.e., research pushing innovative science and operations pulling needed science to fill operational gaps). To keep transition projects from stalling, an R2A capitalization fund would help overcome funding shortfalls.

Accountability for R2A results and the management oversight needed to overcome challenges are sporadic across NOAA, with some programs well established to provide both while other R2A efforts are languishing without either. NOAA culture needs to value R2A activities, and recognize that they need senior management checkpoint review and approval. Successful R2A programs in NOAA, such as the NEXRAD program, have a flexibility and spirit of cooperation between the research arm (OAR/National Severe Storms Laboratory) and operational arm (NWS/Office of Operational Services/Radar Operations Center) that have an established culture for transitioning projects and places NOAA interests above those of the individual Line Offices. For those times when there is a fundamental difference in positions between the Line Offices, a third-party arbiter is needed to resolve stalemates. MADIS is a recent example of this case where a disagreement on the preferred solution between OAR and NWS was resolved by an executive committee. From the portfolio management perspective, the LOTMs have assisted some projects in moving forward in R2A by identifying and supporting those projects that must get done.

Utilizing transition tools (e.g., testbeds) and defining performance metrics promotes timeliness, transparency, trust, and commitment from both the research and application entities that is needed for successful transitions to occur. Cross-NOAA state-of-the-science assessments are needed to first accurately and comprehensively identify gaps in NOAA services. Then, once research projects reach an adequate level of scientific maturity, transition plans must be written and signed by the LOTMs as contractual mechanisms. What is essential is a clear understanding of processes and performance metrics by both sides of the R2A equation. That is to say, research and application organizations within NOAA need a strong binding NAO that is followed by all, with people held accountable when it is not.

VII. What research might be transitioned over the next 5 years?

NOAA is a respected, recognized leader in the environmental forecasting arena with mandates to expand its capabilities. Demand for improved, integrated, and broader NOAA forecasts is increasing.

An example of NOAA's expansion in capabilities is in ecological forecasting. Ecological forecasts comprise a developing product line. Two examples of early successes are the sea nettle forecasts in the Chesapeake Bay (currently experimental product and proceeding through NWS's OSIP, and HAB forecasts and the plans to expand the operational forecasts from Florida to Texas (and ultimately nationally, if funding for project continues). However, for the NOAA Ecological Forecast System (EFS) to achieve its vision there are two unique R2A challenges that must be overcome. First, ecological forecasts are being developed within NOAA without a cohesive, corporate approach or inclusion in NOAA or LOTM's planning. Second, what makes ecological forecasts particularly challenging is that it requires multi-line office collaboration and cooperation (NWS, NOS, OAR, NMFS, NESDIS). These forecasts are by definition NOAA forecasts, not NWS or NOS forecasts. To reiterate, currently there is no corporate approach, with no institutional "owner" or "champion". Ecological forecasts could be used as a test case for applying results of this study throughout their life cycle.

Ecological Forecasting is only one example of how multiple-LO projects may not be successful in transition. A large number of other projects are ripe for transition, but face the same technical and political challenges of transitions throughout NOAA. From a holistic perspective, transition projects and transition planning over the next 5 years need to proceed with the guiding principles of *integration* and *impact*. Transitions cannot occur within a vacuum, as transitions of individual projects. The entire portfolio of transition projects need to be integrated across NOAA in a way to maximize the societal impacts or outcomes.

VIII. What are the best procedures, approaches, and capabilities that NOAA can employ?

The Team has identified nine R2A improvements to help NOAA overcome the “valley of death”. They are listed (in random order) below and further described in greater detail in this section.

- (1) Make investment decisions based on outcomes, not just outputs;
- (2) Institute end-to-end transition planning agreements as early as possible between the researchers and operators to avoid R2A resource shortfalls;
- (3) Implement NOAA-wide requirements process to ensure research, development, and operational or user communities are responding to well-defined, validated requirements;
- (4) Ensure accountability and oversight of R2A projects and activities through performance plans of all involved, including senior leadership;
- (5) Value and give priority to ongoing and successful R2A transitions in the budget system;
- (6) Reform institutional structure to facilitate transitions;
- (7) Update the NAO;
- (8) Establish transition incentives such as funds or place the topic in performance plans; and
- (9) Develop and use transition tools, such as testbeds and operational proving grounds.

NOAA investments decisions must be made based on outcomes (i.e., societal impacts) as well as outputs in the decision making process. Currently, NOAA is output-oriented. To become outcome based, NOAA needs to:

- Change this by developing, implementing, and evaluating realistic logic models for linking research, transitions, and operations to NOAA’s mission through the Strategic Execution and Evaluation (SEE) process.
- Measure both outputs (e.g., amount of research transitioned into applications) and outcomes of transitions (e.g., what difference did a transition make relative to NOAA’s mission), realizing that outcomes may become evident only after several years.
- Evaluate success of transitions against desired outcomes (at least annually). NOAA needs to use the existing NWS “Transition of Innovation and Research to Operations” policy directive (signed March 29, 2010) as a model for developing policies within and among each Line Office.

However, measurements of outcomes instead of outputs are much harder to do in that very disparate transition projects can be difficult to objectively prioritize.

End-to-end planning was inadequate and broke down in execution with the PPBES process. The new SEE process attempts to simplify, link to appropriations, and include evaluation and logic models that convert activities into outcome evaluation. A purpose of the SEE process is to ensure successful implementation of NOAA's Next Generation Strategic Plan (NGSP). However, oversight by the LOTMs of the SEE process must occur to ensure transitions are adequately planned for and executed.

The Team has identified 6 critical steps to successful end-to-end planning:

- (1) Insert language in the NGSP that identifies R2A as a necessary prerequisite to achieving NOAA's mission (completed);
- (2) Insert language in the Annual Guidance Memorandum (AGM) that identifies R2A as a core principle and high priority of the NOAA Administrator (completed for FY13);
- (3) Engage in development of SEE Implementation Plans through the NOAA Research Council;
- (4) Sign agreements for appropriate research activities between research and operational offices ("every pitcher needs a catcher");
- (5) Propose a transition path for appropriate research projects including a budget for transition and operational costs;
- (6) Evaluate performance measures for research transitions to operations (starting in FY12).

Transitions typically do not occur when there is no clear handoff agreement between research and applications. Planning discipline for transition projects must be executed in the NOAA budget process (i.e., plan with "real" money) with oversight by the LOTMs. Transition plans can follow already existing templates from NWS OSIP, NESDIS Science Review Board, or the NOAA Transition Plan template within the NAO 215-106 Implementation Procedures.

A NOAA requirements process for transitioning multiple Line Office projects does not exist. Requirements are driven by users and system owners, but there is no requirements process whereby one Line Office provides another Line Office the needed requirements to ensure a successfully transitioned project. One example is the common practice of research performed on non-operational and sometimes even non-compatible systems or platforms. Transitions that require a rebuilding of the infrastructure, software code, or any other incompatibility greatly increases transition costs. These costs can be reduced significantly within testbeds or operational proving grounds, which use an operational platform to perform research.

Wherever possible, research should be performed within the constraints of operational systems (e.g., AWIPS). Absent requirements, transitions become amorphous, unrealistic, and ultimately do not occur. Without transitions, outcomes don't change.

Accountability and oversight is being performed in an ad hoc fashion by the different Line Offices. The NAO 215-106 is essentially out-of-date. In practice, the cost to follow the NAO is too high, and without clear accountability existing, the NAO is inconsistently followed or ignored entirely. Even transition successes are not highlighted or comprehensively acknowledged for recognition.

The highest levels of upper management need to be clearly educated on the role of R2A as a fundamental core capability of NOAA. This Team recommends that R2A roles and responsibilities be added to upper management performance plans. To make this happen, the NAO 215-106 needs revisions along with the implementation procedures to include clearer execution of duties and accountability. Transition projects need to be required to include Annual Operating Plan (AOP) milestones, with the LOTMs being accountable for meeting transition milestones. The Team also recommends the creation of a web-based database of NOAA's R2A accomplishments, projects in the R2A pipeline, and posted transition plans. From this database, the LOTMs should widely distribute transition "success stories" and consider creating an R2A Federal Advisory Committee (FACA), or create a subcommittee of the Science Advisory Board to provide outside perspectives on R2A within NOAA. It is the Team's findings that the NAO 215-106 is necessary, but not sufficient; that there is a lack of commitment to the NAO; and what is not measured ultimately does not get done.

The budget system deficiencies are numerous, and the Team concedes that NOAA can only marginally enact change to the budget process. However, there are tangible improvements that can be made to improve R2A transitions. A starting point is to demystify the budget process by increasing the transparency of budget decisions. It is widely acknowledged that the critical failure of PPBES was that planning did not translate into execution, that the "PP" was not reflected in the "BE". The SEE process is attempting to overcome this shortfall. In linking to the end-to-end planning needed for successful transitions, funding estimates must include transition costs as well as operations and maintenance (O&M) costs in out-years for mature research projects entering the transition phase. Related to this, the commitment made to fund research must also have the commitment to fund the transition and O&M (i.e., research, transition, and operational budget line items). The LO and NOAA planning and execution budget offices must be part of the R2A planning from the beginning.

Operational organizations need to assess baseline costs and prioritize against new capabilities. Incentives must be built into the R2A process for operations to accept new applications, and researchers to "let go" of mature research. The Team suggests that an independent evaluation of operational systems be made for the purpose of identifying unnecessary products/services that can be eliminated. The Team finds that there is an inability for operational organizations to

significantly increase capabilities (i.e., operational resources are often cited as “red-lined”). Three potential reasons for this are the increasing resource demand for IT security, difficulty within NOAA to terminate out-of-date products/services, and the stovepipe syndrome of multiple independent systems. When transitions fail, or are delayed, the research organizations often default to “quasi-operations” within the research infrastructure. By doing so, the research organization is prevented from advancing forward on other research needs.

As a starting point in the budget process, NOAA needs to raise awareness to Congress that R2A is a core element for NOAA’s success. An R2A line item should exist in NOAA appropriations. Implementation plans within SEE must be realistic and not include “everything and the kitchen sink”. As research projects become mature, transition plans between Line Offices should include cost estimates with alternatives identified (e.g., scaled down alternative solutions). However, at the earliest possible time, agreements (e.g., Letters of Agreement, Memorandums of Understanding) must be based on appropriated funds.

Institutional structure of R2A processes is lacking within NOAA. This lack of formal structure for implementing transition processes leaves researchers and program managers “on their own” and impedes progress. More often than not, it is dedicated people who recognize the importance of transition at the working level who try to “figure out” ways to make a transition happen, even when not supported by higher level managers. To overcome this deficiency in institutional structure, the Team recommends the following:

- Include transition activities in performance plans throughout the personnel hierarchy
- Formalize testbed or proving grounds in the transition process
- Incorporate a revised and updated NAO 215-106 into the Committee for Monitoring Research handbook (handbook currently under development)
- Examine the utility of “Research to Operations Letter of Agreement” between NWS and NOS as a model for maximizing integration across the Line Offices
- Create web-based database/web repository of R2A information

Improving the transition process is an iterative effort. Three years have elapsed since the last robust examination of R2A within NOAA which led to the formation of the LOTMs. Transparency and collaboration can still be improved. Redundant efforts can be reduced. Pre-existing capabilities can be better leveraged. R2A efficiency can be improved by identifying similar mission needs across the agency. There is no shortage of needed improvements.

The Team recommends the LOTMs and associated staff continue to change the R2A culture in overcoming the “Valley of Death”; specifically, continue with the LOTM monthly meetings, the RITT monthly forums, the annual NOAA Technology Summit, the project-level data collection,

and spend additional time prioritizing transition portfolios. One additional possibility is to extend OSIP (or an OSIP-like process) when appropriate as a tool used across NOAA.

Transition incentives need to exist to further highlight the importance of R2A within NOAA. Researchers currently earn recognition and rewards solely on the contents of the research, and not necessarily based on any successful transition of that research into applications. In fact, research organizations seemingly get punished by completing transitions as there is a loss of research funding when the projects get completed. To combat this loss of funding, transitions often occur with “strings attached” where the research organization still holds onto essential components of the project. If the transition does not occur, then the research does not create an outcome, as the title of this white paper emphatically declares. In addition to research excellence awards, researchers should earn financial awards, recognition, and be rewarded with future funding of new research proposals when the research is transitioned to an application (e.g., operational organization). This Team recommends the creation of a steady funding stream dedicated only to transition incentives.

Transition tools, such as testbeds or operational proving grounds (OPG), should be formalized and used in the transition process. An additional tool is the use of independent peer review to investigate the progress made under the current R2A NAO with recommendations moving forward.

Testbeds and operational proving grounds (OPG) are both longer-term activities that have individual projects move into and out of them in an effort to transition into operations. They differ slightly in that testbeds are research environments attempting to identify potential applications in operational use, while OPGs test within an applied or mock operational environment until a decision is made to transition the capability into full operations. Testbeds and OPGs are useful because they provide a durable structure for transition and provide a transition decision process. In other words, a research initiative enters the testbed or OPG and doesn't leave until either the initiative is terminated, or a decision to transition is made. A profound advantage of testbeds and OPGs is the ease to which external partners can participate either through grants, cooperative agreements or contracts to increase the pool of expertise. Testbeds in particular focus on science themes (e.g., hurricanes, high impact weather, ecosystem modeling, etc.) where expertise is accumulated and not stove-piped into a single project. Currently, there are a handful of testbeds with an OPG component. They include, but not limited to:

- Joint Hurricane Testbed (partnering with the U.S. Navy)
- Developmental Test Center (modeling collaboration with NCAR, Air Force, Navy)
- Joint Center for Data Assimilation (satellite data collaboration with NASA)
- Hazardous Weather Testbed (multiple partners participating)

- Hydrometeorological Testbed (multiple partners participating)
- Climate Modeling Testbed (multiple partners participating)

A deficiency with testbeds and OPGs is that they are not well publicized within NOAA, with little if any coordination or oversight across all the testbeds. To correct this deficiency, the Team recommends establishing a coordinating committee for testbeds and OPGs under the LOTMs, who can facilitate collaboration and monitor and report on activities to the highest levels of NOAA. There is also a need to establish guidelines for testbeds and OPGs to define their core best practices. A measurement of success to address these needs is for the NOAA Administrator to be able to explain how NOAA's testbeds and OPGs work and what they do at a high level.

IX. Transitions for Emerging Collaborative Science, Service and Stewardship

The convergence of science disciplines from physical to ecological and behavioral to economic when effectively and efficiently transitioned hold the opportunity for superior integrated science solutions, environmental services and management outcomes. As a case in point is the emerging capability for NOAA, in coordination with partners, to advance environmental assessments and ecological forecasts. This is not to say the ecological forecasting is the only type of cross-Line office emerging collaborative capability, rather transitional improvements are urgently required in many cross line office areas, but it was examined in this report by the transition team to identify and highlight the type of issues and improvements in R2A that will have broad benefit to the organization.

Consider, the harmful algal bloom forecasts resulting from NOAA research and currently operational in NOS as among some of the earliest and most well-known in the suite of ecological forecast that NOAA can deliver. However, there are on the order of ~40 potential ecological forecasts that NOAA and partners have innovated, tested and demonstrated, as well as the associated observations, models, and educational capabilities that are in the pipeline for operational applications and management practice. To fulfill the vision of an “Ecological Product Line”, a number of R2A issues must be addressed.

A framework for the long-term application/operation of ecological forecasts does not exist and has led to major issues needing attention:

- “Orphaned” forecast products (no path to operations effectively wasting development effort)
- “Blocked pipeline” for new products (a backlog waiting to transition)
- “Backbone” capabilities not utilized or leveraged
- “Ad hoc” development creating inefficiencies
- “Holistic” management not achieved resulting in a lack of integration

The deleterious effects of these issues will only accelerate as field efforts mature and management demand and requirements increases.

Since 2006, an informal, cross-NOAA team has worked to foster the notion of ecological forecasting. They have briefed the NOAA Ocean and Research Councils, Science Advisory Board’s Ecosystem Science and Management Working Group, NOAA’s Administrative Assistants, key supporters, and the external community at scientific meetings. However, a formalized approach is still necessary for progress. The team has proposed a path forward in the form of a NOAA Ecological Forecasting System (EFS) that is described within the NOAA Ecological Forecasting System Resolution that states:

- Endorse the creation of a NOAA Ecological Forecasting System and scope out a concept of operations and business plan for such a system
- Take necessary actions to develop and operate a broad suite of integrated forecasts, including some of the recommendations included in this report
- Formalize the establishment of an Ecological Forecasting System Working Group (EFSWG) potentially within the NGSP Coastal Goal to support NOAA's Coastal Strategy to fully identify and explore the issues contained in the first 2 bullets above
- Nominate official LO representatives to the EFSWG and include EFSWG accomplishments in their performance plans
- Support the establishment of a pilot EFS prototype in the Chesapeake Bay area with personnel and financial resources

The Team recommends that the LOTMs solicit the NEP to adopt the NOAA Ecological Forecasting System Resolution.

X. Summary of Transition Tiger Team Recommendations

Below is a list of recommendations to the LOTMs. Specific actions are proposed in appendix A.

- Engage in SEE process
- Update NAO 216-105 and implementation procedures
- Explore the LOTMS becoming a subcommittee of the NOAA Research Council
- Report annually to NOAA Administrator
- Interact with Congress to highlight need for R2A funding support
- Publicize outcomes, outputs, and results
- LOTMs, as an entity, “own” and champion R2A
- Request independent peer review of progress
- Explore R2A Federal Advisory Committee Act (FACA)
- LOTMs “own” Ecological Forecast System development

XI. Conclusion

Since the sunset of the NOAA Transition Board, the LOTMs have experienced some successes. Specifically, cross-LO communication/collaboration has increased, resulting in raised awareness of R2A issues, and the triaging of individual projects. However, more work is needed. There is still inadequate funding, accountability, and incentives for transitions to occur optimally. There is incomplete or difficult to find information on R2A, even the successes. From a policy perspective, the NAO 216-105 is out-of-date and followed in bits and pieces, if at all. The NAO needs updating to encourage Line Offices to adhere to the policy.

For R2A, corporate NOAA lacks recognition of its importance, lacks end-to-end planning of R&D, and lacks accountability and funding. Each of these items is intimately related. If R2A importance is recognized, then commitment follows and the other factors fall into place.

Appendix A: Proposed actions.

Proposed Action	Lead Org	Target Date
Create “NOAA Transitions” section from RITT website, then socialize	RITT	FY11 Q2
Update NAO 216-105 and implementation procedures	PPI or CMR	FY11 Q2
Explore LOTMs becoming Sub-Committee of Research Council	LOTM/Staff	FY11 Q2
Build sustainable connections with SEE process	LOTM/Staff	FY11 Q2 and beyond
LOTMs endorse EFS Resolution and present Ecological Forecast brief to NEP	LOTM/Staff	FY11 Q3
Implement a pilot R2A Ecological Forecasting effort	LOTM	FY11 and beyond
Evaluate transition priorities based on outcomes (not outputs)	LOTM/Staff	FY11 and beyond
Create NOAA Transition List of Projects with signed transition plans	LOTM/Staff	FY11 and beyond