



## **Post-Workshop Report**

NOAA Line Office Transition Managers Committee (LOTMC)



NOAA Technical Memorandum NOAA Line Office Transition Managers  
Committee-001

# NOAA Readiness Levels Workshop: Post- Workshop Report

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August 2020

National Oceanic and Atmospheric Administration  
NOAA Research Council  
NOAA Line Office Transition Managers Committee  
Silver Spring, Maryland



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## A Note from the Line Office Transition Managers Committee

DEAR COLLEAGUES,

Readiness Levels (RLs) constitute a relatively new concept for the National Oceanic and Atmospheric Administration (NOAA), with application evolving over the past few years. The utility of RLs has already been demonstrated, but their full benefits have yet to be realized and much confusion still persists. As such, the NOAA Research Council Line Office Transition Managers Committee ([LOTMC](#)) held a virtual workshop on May 8, 2020 to:

- (1) provide a forum to raise issues with RL assignment, usage, and definition,
  - (2) discuss modifications to, and examples of, categorical definitions of “things” that transition,
- and
- (3) develop plans both to establish clear, NOAA-agreed on guidance for better RL assessment
- and
- to distribute workshop information and potential NAO 216-105B amendments.

The 50 NOAA personnel that attended the workshop consisted of key representatives from five of the six NOAA Line Offices (all but the Office of Marine and Aviation Operations) whose work at NOAA intersects with project transitions. Beyond providing a background and overview of current NOAA RL policy through formal presentations, the workshop was designed to include engaged facilitated participation. Through two sets of breakout sessions, attendees expressed their concerns with key concepts regarding RLs and what things transition, and offered suggestions, feedback, and examples to improve current policy.

The LOTMC is pleased to provide this report detailing the 2020 NOAA Readiness Levels (RLs) Workshop. This report contains an overview of RL Workshop organization as well as the discussions, analyses, and presentations that occurred before, during, and after the Workshop. The report is intended for NOAA personnel, partners, and external stakeholders actively engaged with NOAA’s current RL policy or have a general interest in the topic. In particular, some intended audience groups include workshop attendees, registrants, NOAA senior leadership, NOAA lab directors and principal investigators (PIs), NOAA R&D Database ([NRDD](#)) users, and personnel that require information regarding NOAA’s RL policy. It is our hope this report provides you with a starting point to better consider the use of RLs within NOAA and how NOAA should move forward as an organization.

SINCERELY,

### **NOAA Line Office Transition Managers Committee (LOTMC) Principal Members**

[Gary Matlock](#) (Chair and OAR representative)

[David Detlor](#) (NMFS)

[Maureen Madden](#) (NESDIS)

[Hendrik Tolman](#) (NWS)

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## Background and Introduction

The first policy regarding NOAA research to applications (R2A) was developed in 2005. Since then, NOAA's research and development (R&D) enterprise has expanded to its current form which emphasizes the transition of appropriate efforts to operations, applications, commercialization, or other uses. The current policy employs Readiness Levels (RLs) to provide a systematic metric and measurement system intended to support assessments of the maturity of R&D projects in the transition process and offer consistent comparison between projects.

Research transition is considered a core aspect of NOAA's mission to facilitate the delivery of constantly improving services and products reliant on the transition of the most current, best research and development (R&D) efforts into operations, applications, commercialization, and other uses. However, since publication of the most recent NOAA Administrative Order ([NAO 216-105B](#)) governing transition and RL policy, numerous questions have been raised across NOAA that indicate there is confusion surrounding the assignment of RLs to specific projects. This confusion has not only limited the positive impact intended from the RL system but has also created inconsistencies in RL assignments between NOAA Line Offices (LOs) and on how much time and funding should be spent assigning, evaluating, and analyzing RLs. As a result, the RL Workshop was held to better understand the confusion and work towards solutions to improve the implementation and assignment of RLs.

The workshop, held virtually (Google Meet) on May 8, 2020, included 50 participants (see [appendix](#) for detailed list) representing high levels of participation from all LOs that work on R&D projects ([Figure 1](#)), as well as additional support staff and facilitators. Beyond providing background and an overview of current NOAA RL policy through formal presentations, the workshop was designed to include active participation. Through two sets of facilitated breakout sessions and the main presentation chatroom function, attendees expressed their concerns with key concepts regarding categorization of things to transition and RL definitions and policy, and offered suggestions. Attendees were also given the opportunity to provide feedback through a post-workshop survey (template found in [appendix](#)) or by directly contacting the workshop coordinator. The workshop concluded with attendees volunteering to participate in a new RL Taskforce that would either offer specific suggestions for moving forward or produce deliverables to clarify the RL system and improve use, understanding, and compliance based on Workshop feedback.

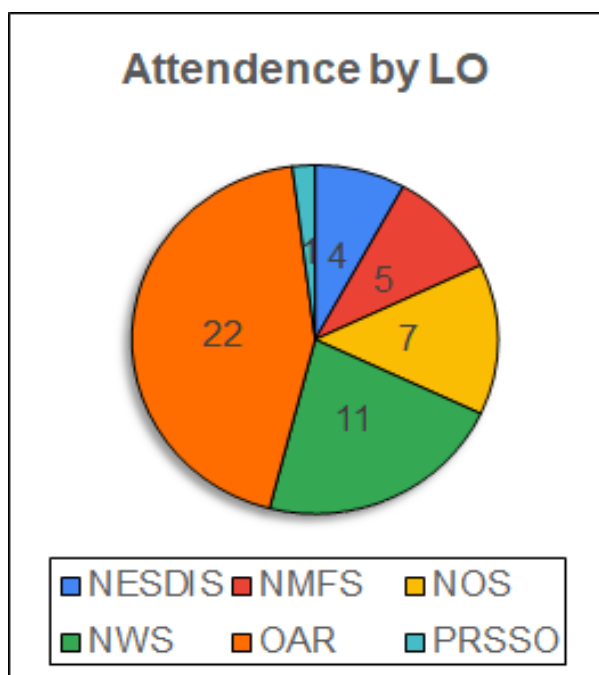


Figure 1. Attendance to the RL Workshop by Line Office. National Environmental Satellite, Data and Information Service (NESDIS), the National Marine Fisheries Service (NMFS), the National Ocean Service (NOS), the National Weather Service (NWS), the Office of Marine and Aviation Operations (OMAO)

## Workshop Goal, Objectives, and Intended Deliverables

### Goal

The goal of the 2020 NOAA Readiness Levels Workshop was to improve NOAA RL and transition understanding, particularly what each RL means and how to assign appropriate RLs to a project.

### Objectives

- Provide forum to raise issues/comments on RL assignment, usage, and definitions
- Discuss modification for things<sup>1</sup> to transition definitions and examples of each
- Establish plan to develop clear, universally (NOAA) agreed on guidance to more easily assess RLs for different transition types<sup>1</sup> (including checklists, milestones, and decision trees for each transition type)
- Develop a plan to disseminate workshop information to NOAA and potentially amend NAO 216-105B

### Intended Deliverables

#### *Before and during workshop*

- Provide a forum to identify issues with the RL system (assignment, usage, etc.)
- Identify possible solutions for improving use and compliance of RL system

#### *After workshop*

- Produce a workshop report outlying main points and discussions
- Consider workshop/survey results for modification to NAO 216-105B and Handbook
  - Finalize definitions for each thing<sup>1</sup> to be transitioned
- Develop tools for improving RL use, accuracy, and understanding
  - Checklists of RL criteria, milestones, and decision trees for each thing<sup>1</sup>
  - Possible development of an RL training module

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<sup>1</sup> system, process, service, tool, product, or assessment



## Pre-Workshop Data

Prior to the RL Workshop, the LOTMC provided examples of transition in a [transition matrix](#) (also see [appendix](#)) to aid in workshop preparation, planning, and survey creation, and in the generation of preliminary analysis to be shared during the workshop. The matrix was filled out with representative projects from each LO that have already transitioned or are intending to transition. Major categories in the matrix included LO, current RL value, thing to transition (although a formal definition of the [six categories of things to transition](#) had not been provided), and explanations on how the thing category and RL were selected. A summary of data in the transition matrix can be found in [Figure 2](#) and analysis is provided on the first tab of the [matrix](#).

A pre-workshop survey (template found in [appendix](#)) was also created and distributed to all invited workshop guests as well as other NOAA personnel actively engaged with RLs (such as NOAA R&D Database (NRDD) “super-users”). The survey was also designed to help participants review relevant issues, further identify challenges with current RL classification, give attendees an opportunity to articulate their problems with the current RL system in advance, and provide information to sort breakout groups. The survey was split into three main sections: (1) sample project RL evaluation; (2) categories of things to be transitioned; and (3) challenges applying the NOAA RL system. Sample projects were modified from examples in the transition matrix and the NRDD to provide details needed to identify the intended project RL. Survey takers were provided with the current [NAO 216-105B handbook RL definitions](#) and asked to rate the RL of the sample project and the difficulty of this task. Sample project topics were selected to provide as much diversity in LO origin, technology and social science focus, and RL values as possible for a limited number of questions.

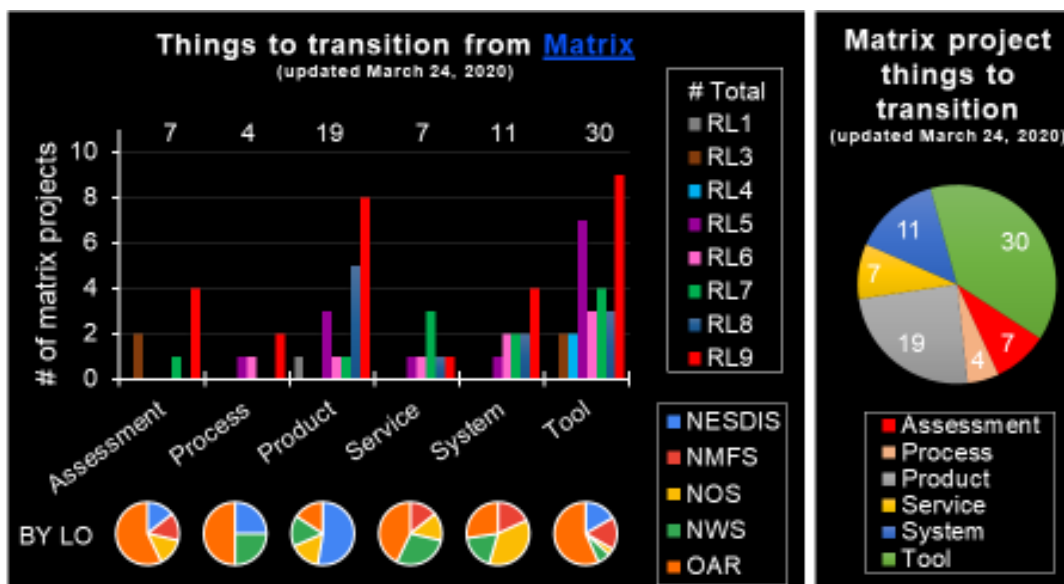


Figure 2. Projects entered into the RL transition matrix by March 24, 2020. (A) RL values listed for each category of thing to transition (above) and the percentage of projects within each Line Office (LO) classified by each thing type (lower). (B) Percentage of projects in the RL Transition matrix by thing type.

## Overview of Session Presentations and Breakout Groups

The NOAA Readiness Levels Workshop began with an overall introduction to the main topic and continued with three main workshop sessions (see agenda in [appendix](#)). The introduction and workshop sessions each started with a main presentation by the LOTMC Chair (Gary Matlock) that provided workshop attendees critical background information, details, and preliminary analyses (see [Pre-Workshop Data](#)). An overview<sup>2</sup> highlighting key presentation concepts and of the breakout groups is provided below.

### Introduction

The introduction presentation provided a groundwork explanation for why the workshop was organized (also see [Background and Introduction](#)) and the overall importance of NOAA RLs. The LOTMC Chair reviewed how transition is critical towards achieving NOAA's mission, the history of NOAA R&D policy, why NOAA tracks R&D, and that RLs represent NOAA's primary method for tracking R&D movement. A key component of the introduction was an explanation, including in-depth examples, of the multiple functions accomplished by RL project evaluation. RLs are included in congressional reports. They also serve as tools for improving economic assessment, quantitative progression metrics for Principal Investigators (PIs) to advocate for resources/funding, and as aids for project transition planning and resource and funding allocation based on similar project types.

### Session 1 – Categories of things to be transitioned

The first main workshop session focused on classifying (by “thing”) what NOAA R&D projects actually transition. After reviewing the current [NRDD project definition](#), Gary Matlock described the six categories of things to transition (Assessments, Tools, Products, Systems, Processes, and Services), and where the terms originated from in the context of NOAA R&D ([NAO 216-105B](#), section 2.1). The LOTMC Chair emphasized this categorization could be useful by providing more focused methods for RL assignment and evaluation within each thing category, and by enhancing methods to examine transition trends among thing types and between categories to determine how best to support different transition types. Workshop attendees learned that there currently is no formal [definition for the six categories](#) beyond what has been modified from an OAR technical memo<sup>3</sup>. Based on those existing definitions, the main presentation for session one concluded with Gary Matlock providing examples from the pre-workshop survey and NRDD of the six categories and reviewing related clarifications, suggestions, and misconceptions identified from RL [transition matrix](#) analysis.

Following the main presentation, the workshop coordinator presented relevant major results from the [pre-workshop survey](#). The presenter emphasized that although nearly 18% of survey takers felt no changes were needed, most provided a highly diverse set of responses concerning how to improve and edit the proposed definitions, or how to change the number or use of the categories. The coordinator described how the responses were grouped into multiple themes (such as specific definition changes, definition overlaps, nomenclature clarification) and reviewed important examples from these groups. Pre-workshop survey results providing examples to assist with classification were also presented.

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<sup>2</sup>This overview is not intended to serve as a full presentation. The original workshop presentations and associated recordings are provided in the [appendix](#).

<sup>3</sup>Sen A. (2015). NOAA Technical Memorandum OAR PPE-5. [What Does “Transition” Mean? A Qualitative Analysis of Reported Transitions at OAR.](#)

## Session 2 - RL definitions and challenges

The next main workshop session focused on RL definitions and policy. Gary Matlock began by explaining that RLs are used to evaluate and facilitate project transitions and continued with a review of the RL system definition and categories, and overall RL policy found within NAO 216-105B and the associated handbook. The LOTMC Chair emphasized that projects intended for transition do not only progress from R&D to operations, applications, commercialization, or other uses (R2X) but that these uses also facilitate new R&D efforts (X2R). Gary Matlock next reviewed each RL definition (including examples) and often-overlooked policy guidelines, and provided an example transition plan template. To highlight NOAA-wide confusion with RL evaluations, the presentation included results from the [pre-workshop survey](#) sample questions. Survey results ([Figure 3](#)) showed a large dispersion in responses for RL value assignments of various sample project types. However, the most common answer matched the intended RL for all but one question. Beyond reaffirming overall confusion with RLs, survey results indicated a disconnect between RL evaluation confidence and accuracy. The main session presentation ended with a review of additional reasons for RL confusion identified through [transition matrix](#) analysis.

As with the previous session, the main presentation was followed by a summary of pre-workshop survey responses related to RLs. The workshop coordinator explained that a low number of respondents indicated they had no challenges with understanding/applying RLs (10%) and no concerns with the current policy (6%). However, the majority of survey takers provided a wide-range of responses identifying challenges and concerns with current RL policy, as well as understanding and using the current definitions. Survey takers also suggested various methods to improve the understanding, application, and compliance of the current RL system and indicated the many ways in which they personally used and benefited from RLs. Survey responses were grouped into main themes and discussed during the workshop (see [appendix](#) for presentation and recording links), and will be provided to the RL Taskforce (see [Report Conclusions](#)).

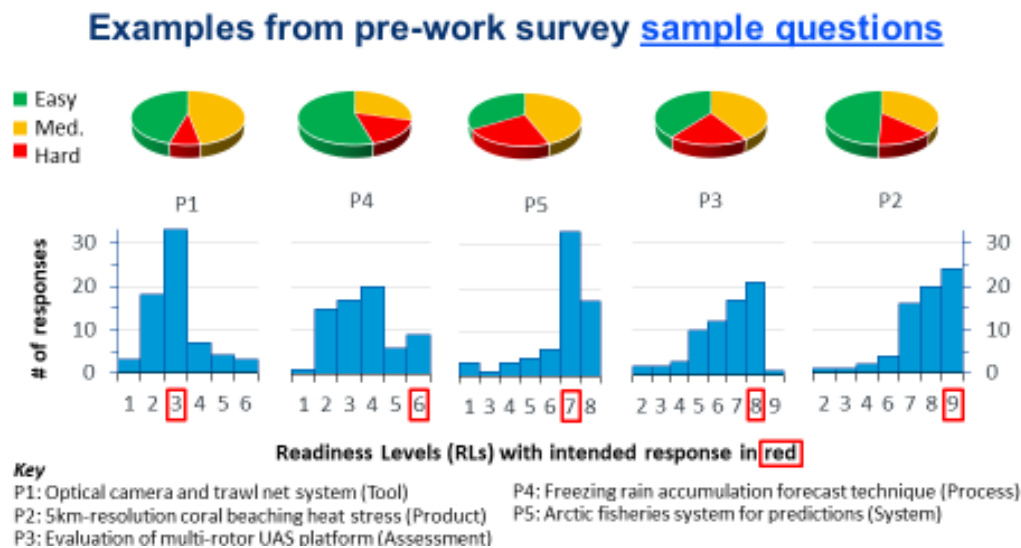


Figure 3. Results of pre-workshop survey sample project (P#) RL evaluation. The pie charts indicate survey-takes responses regarding how difficult they thought it was to provide an accurate RL value to the sample project provided. Numbers in red boxes indicate the intended answer to the survey question.

## Session 3 – Final product plans and next steps

The workshop concluded with a discussion on post-workshop actions. The LOTMC Chair detailed a plan to use results from workshop conversations and associated material to both consider changes to NAO 216-105B and/or the associated Handbook and to develop products that will improve RL application and understanding. The development of an RL training module was also discussed. Volunteers for a post-workshop RL Taskforce were requested from all LOs and breakout groups to assist completing the post-workshop actions. Several workshop attendees volunteered in the main chatroom while others announced their intent to volunteer afterwards.

### Breakout Groups

Six breakout groups were organized for the first and second workshop sessions and were given 30 minutes during the first and 45 minutes during the second session to allow for more active participation, discussions, and debate that may not have been possible in a larger virtual group setting. The breakout groups were organized by the six proposed categories of things that transition in NOAA based on preferences indicated in the pre-workshop survey (question found in [appendix](#)). When possible, at least one representative from each participating LO was placed in each of the evenly assigned groups. (breakout group participant list found in the [appendix](#)).

## General Workshop Results

One major goal of the pre-workshop survey was to capture general concerns, feedback, and suggestions regarding the main RL Workshop topics. This potentially would allow more time for breakout groups to develop usable compilations of comments and suggestions directed specifically towards each category of thing to transition and assist with producing intended deliverables. However, pre-workshop survey responses and chatroom comments during the main presentations indicated attendees still had many diverse, general fundamental concerns they wanted to further discuss during the breakout sessions. The proceeding section in this report presents a synthesis of key workshop results, organized by the two major sessions and suggestions for improvements, from a general perspective (not by each thing type) without commentary or quantification. The section includes feedback from the breakout groups as well as from the workshop chatroom (see [appendix](#)), the post-workshop survey, and additional correspondences received after the event. Additional results from [pre-workshop data](#) analyses were presented during the workshop (see [appendix](#) for presentation links) and are generally not repeated in this section of the report.

### Things to Transition (session 1)

Overall, workshop participants found the practice, purpose, and/or usefulness of classifying projects by “things to transition” quite contentious. Major fundamental questions from participant responses included asking if the definitions should exist and be used at all (and to what benefit), and if the general concept (number of categories and how they are used) should change. When describing the classification system, the term “thing” was said to devalue the overall concept and participants suggested alternatives such as “activities”, “value propositions”, or “outputs”. While the pre-workshop survey indicated some attendees had no problem with the classification system, others found the system useless, unnecessarily complicated, or lacking continuity with the NRDD. Specifically, one workshop attendee felt that “adding one ambiguous, subjective framework [the classification system] to bring clarity to another ambiguous, subject framework [RLs]” lacks usefulness, despite the fact that one of the goals for the classification system was to create more specific RL evaluation guides based on the different thing categories. Related, various participants stated that the existing category definitions make RL determination more difficult. Some attendees noted that many NOAA projects fit into more than one category and as a result, they questioned the value achieved with the categorization. However, others responded that RLs measure maturity so categorization may allow for more consistent RL assignment because RLs are currently too detailed and should be streamlined so details can be specified in transition plans. They also noted that effective criteria for progressing across RLs is critical.

#### *Issues with definition*

Concerns with definition ambiguity, such as when a project meets the criteria for classification into multiple categories (overlaps) arose frequently during the workshop. One participant noted a single R&D project may result in multiple “things” being transitioned, making a one-to-one project to transition assumption confusing. However, another attendee commented that having to identify all the sub-components of a project that may transition would significantly increase the amount of pages in proposals and transition plans (and time for preparation). Beyond overlaps, participants found the existing definitions too reflective of OAR and not other LOs, too verbose and lacking plain language, and generally difficult to work with. Participants also commonly mentioned the definitions are too technology-focused and need to better incorporate NOAA’s R&D social science contributions. Another difficulty observed was that the terms used for the categories and within the definitions have different meanings for various LOs and in the English language. To deal with this issue, participants suggested NOAA needs its own lexicon agreed upon by all LOs. There was also concern that other federal agencies do not use the six terms outlined for the classification system so there would be a need to align with federal partners. Regardless of any changes to the definitions, participants said better coordination is needed between the definitions to ensure consistency and that they encompass all NOAA R&D efforts.

### *Classifying project types and questions with classification policy*

Beyond general issues with the classification system and definitions, participants indicated confusion on how to classify certain project types and asked important questions that require further attention. Specifically, there was uncertainty on how to classify models (as they represent different “things” and have multiple components), data streams, molecular assays, and algorithms. One participant also recommended caution with classifying software into only one category because it “is a mechanism for building many other things.” Other important questions brought up included asking if: (1) adding examples would make the definitions too specific and confusing for users; (2) the goal is to categorize research output or application (because they are related but different concepts); and (3) it is required that each “thing” go through all RLs. Ultimately, there appeared to be a large amount of confusion with the categorization concept. To fix some of these issues, one participant suggested a bottom up qualitative analysis using a sampling of projects from each LO coded by different transition types and examination of clear examples from each LO.

## NOAA RL System (session 2)

As with the categorization concept, participants found the NOAA RL definitions and policy confusing (e.g. ambiguity with assigning RLs), cumbersome, or in need of major change if possible. As a result, one participant stated that RL policy and definitions should derive from projects; projects should not have to change to fit an RL system that risks being overly prescriptive. Other participants asked what the real purpose and/or benefit was of selecting specific RLs for projects, especially if transition plans are used. Some attendees suggested using a project management system instead of RLs, particularly for projects less suited to RL evaluations such as assessments compared to larger projects requiring more funding, personnel, and tracking metrics. Common suggestions for overhauling the current NOAA RL policy included modifying, reducing, or grouping the number of RLs (possibly to four categories) to provide more flexibility and usefulness. These suggestions also stemmed from the challenge participants stated of assigning RLs within the same “phase” such as “development” or “demonstration”.

Other suggestions for major RL policy overhaul included using multiple RL scales for different situations (such as how NASA has separate RLs for applications, tech software, and tech hardware), and better alignment with other evaluation systems from different LOs, Lifecycle Phases (such as those found in OAR’s Annual Operating Plan), and external partners. Another comment highlighted the belief that current R&D policy concentrates on and considers research more than development and that this often results in projects failing to achieve higher RLs. The scientific focus of RLs constituted another theme for reform. Specifically, many participants voiced concern that RLs are not geared towards all LOs (especially the National Marine Fisheries Service) and do not fully consider social science components of NOAA R&D that may not always need to go through all RLs. Beyond these fundamental policy issues, workshop participants also discussed and provided suggestions for RL management and funding, interpretation of RLs and project components, and specific refinements to definitions.

### *Management, planning, and funding*

Management and funding constituted one major theme from responses regarding RL policy concern. Participants noted the RL process carries a heavy administrative burden while still posing difficulty for proposal reviewers that often lack enough information to assess RL accuracy or for personnel to identify when a project has moved RLs. Related, it was stated that trying to codify all possible transitions is a daunting task that may increase bureaucracy more than improve efficient transitions. Participants suggested a more balanced approach may be to define RLs by what level of funding they have and how funding has been used. However, others worry there could be motivation for PIs to misrepresent project RLs to meet funding requirements or opportunities, representing a major failure of the intended purpose for the current policy.



Communication was another major management-related concern. Specifically, participants stressed the need to better communicate to NOAA personnel that RLs and transition plans represent a business concept as well as a technical exercise. Workshop attendees also indicated there was a need to improve RL-related communication with partners outside NOAA (especially in terms of grants) and to better communicate the specific role of R&D versus operations and of PIs versus operators, and the need for transition managers. While RLs are useful for developing partnerships between developers and users (operations), participants commented this did not actually happen quick enough and often leads to disagreements between the different sides such as with financial responsibilities. Additionally, there was a comment that NOAA grants are limited in the transition activities that can be funded, and often a separate funding source is needed to cover transition costs. There were also questions regarding if the current policy requires PIs to become RL policy experts and if this is too much to put on the PIs or if it is too difficult for NOAA Points of Contacts (POCs) of external partner PIs. Participants also had issues with RLs and transitions related to the NRDD such as general difficulties with implementation and use, and having one RL define all aspects of a project. Regardless of how RL management issues are addressed, one participant stated that the current RL policy does not help solve many current management problems underpinning successful transitions. These include a lack of funding/resources for acquisitions (leading to numerous projects stalling at RL7), and a lack of understanding on how to assign RL values to prioritize which projects move forward and which receive the most investment.

### *Transition plans*

A subset managerial source of confusion and concern revolved around transition plans. Participants questioned what commitments transition plan signatures truly represent in terms of support and funding, if RL4 was too early to include a business case for projects because plans often change with time, and if projects may stall at lower RLs because of transition plan requirements. Some attendees suggested using the term “transition visions” to better express the non-binding mentality of transition plans. Other participants asked if there was a clear process for scientists to know how to fully comply with transition plan procedures. In general, workshop attendees noted there is a need for better engagement between NOAA managers and scientists to drive transition and that transition plans greatly assist with this by facilitating key discussions, decisions, and partner coordination.

### *RL linearity and project components*

Two of the most debated issues regarding current RL policy were the rating of multiple project components and non-linear progression through RLs. Participants indicated that multiple components of a project (especially for systems) may be at different RLs and felt it was not fair for an entire project to be categorized by the lowest RL; this rating may impact funding or project credibility and undervalue the project. These comments led to suggestions for RL classification of “sub-deliverables” or subsets, possibly similar to NASA’s approach to Technology Readiness Levels (TRLs). Additionally, attendees noted that various R&D components may have been used for multiple projects. One outcome of this was that these components need to be evaluated and entered into the NRDD separately. Other participants worried that many projects are multi-layered with iterative components that may increase and decrease in RL values as the project changes, especially when working with testbed evaluations.

### *Interpreting RL definitions*

Discussions from the workshop also focused on the difficulties of interpreting the RL definitions and the terms within. Participants commented that PIs, POCs, academic partners, LOs, and individual laboratories often interpreted RLs differently. This related to the considerable confusion participants expressed with understanding terminology in the governing NAO and handbook. Attendees said the wording in these documents lacks consistency between LOs and could benefit from “plain language”. Participants specifically indicated that they had difficulty interpreting the difference between “relevant environment”, “test environment”, “testbed environment”, and understanding the difference between certain terms like “demonstration” and “prototype”. Related confusion stemmed from overlap with what one participant called environmental descriptors (“laboratory”, “experimental”, “relevant”, “test”, “operational”, and

“user’s”). More examples were outlined in the analysis section of the [transition matrix](#) and discussed during the workshop presentation. At the least, participants suggested that terms within NAO 216-105B and the associated handbook need much more clarification.

### *Refining RL definition wording*

While listing problems with overall interpretation, participants provided a variety of suggestions for slight changes or refinements to existing individual RL definitions (either in the NAO or handbook) to alleviate confusion. One participant provided [specific suggestions for refinement](#) such as: (1) including more demonstrative phrasing to characterize RL achievements (a distinct completed achievement described by past-tense language instead of implying a project is in the process of completing an achievement); (2) distilling a condensed list of environmental descriptors and removing overlaps between concurrent RLs (and removing ambiguous “or” terminology); and (3) condensing phases of maturity descriptions (Basic Research: RL1; Applied Research: RL2; Proof-of-Concept: RL3-5; Prototype: RL6-7; Finalized: RL8-9). Some breakout groups also spent time outlining specific changes or problems with each RL. These suggestions were aimed to ensure RLs follow a logical milestone order or that clarifying language is added (such as writing “development” before RL3-5 definitions), making understanding, adoption, and application a much easier task within the agency.

### *Defining RL8 and RL9*

Participants especially found movement to and from RL8 difficult to understand; one person clarified their belief that all developmental work should be finished before reaching this RL. Participants also struggled to form a consensus on what defined a project at RL9 (the current policy detailing movement to RL9 was reviewed during the session two presentation). Some attendees stated a project could move to RL9 when it is formally accepted for use and introduced into operations but confusion still persisted. Other participants felt the RL9 definition should not only indicate when a project moves into operations but also include guidance on when a project completes its lifecycle and is removed from operations. Difficulties interpreting the RL9 definition also extended to non-operations transitions.

## RL Improvements and Suggestions

One inherent function of the RL Workshop was to provide a forum for suggesting methods to improve RL understanding, usage, and application. Suggestions and improvements stemming from pre-workshop survey responses and analysis of the transition matrix were presented to workshop attendees prior to breakout sessions (see [appendix](#) for presentation links) and will not be repeated in this section of the report. Despite some overlap with pre-workshop data, feedback from breakout groups, the post-workshop survey, the workshop chatroom (see [appendix](#)), and additional correspondences received after the workshop provided new suggestions that are discussed below.

### *Procedures*

Improvements to procedural management and policy were frequently mentioned during the workshop. These included considering how NOAA RL policy is applied, managed, and/or interpreted and how communication between project contributors and managers is handled. Participants suggested RL transition success must be defined initially and achieved with appropriate metrics, and that clear criteria should be discussed early when “a statement of work” is created, particularly between the researcher and users. Others mentioned consideration for project lifecycles. This included improving RL user understanding on how to handle when a project ends, is turned off, is replaced by a newer project, or is not needed anymore. Several participants emphasized that the continuous inclusion of end-users in RL assignment is critical, as is consideration for a project's endpoint (e.g. for a service, a presentation may be the endpoint or a deliverable along the path to transition). Finally, one participant recommended that NOAA’s RL policy follow that of NASA’s more directly so that there is more consistency and agreement with inter-agency and industry partners.



### *Leadership, coordination, and expert advice*

Participants often stressed the need for a central location or authority to validate RLs. Suggestions included a peer-review system, improved discussions between program managers and PIs regarding RL movement, and better access to experts and/or guidance for NRDD data enterers to determine RLs. Discussions also indicated persistent confusion on when projects move forward (e.g. how a “successful evaluation” is determined for RL4) and the belief that accurate recording of RL movement requires improved coordination between researchers and users as well as an active NOAA management role to determine project success and progression. Participants expressed the need for NOAA headquarters to better coordinate with all LOs on RL policy to ensure equal guidance, support, and expectations, especially since some LOs are currently developing their own strategies for implementing NAO 216-105B.

### *Training, examples, and devices to assist with RL assignment*

After solidifying RL policy, categories, and definitions, various methods were recommended to improve RL use, understanding, and compliance. Training for both project proposal developers and reviewers, potentially similar to what was held by OAR’s Weather Program Office, was identified as a key solution to RL challenges. Participants said this training should include examples and use all categories and RLs from each LO. It was noted that the Defense Acquisition University (DAU) provides Readiness Level and Technology Readiness Assessments training already well supported, vetted, and paid for by the U.S. Government and currently used by inter-agency partners such as NASA, the Office of Naval Research (ONR), the Department of Homeland Security (DHS), and the Defense Advanced Research Projects Agency (DARPA). Related, one participant suggested development of a webpage for RLs that would host training material, workshop presentations, examples, and applications. The need for examples was also a common theme. Some participants suggested examples need to exist for each RL and be developed to show how the examples are useful (not just provide an example in and of itself).

Beyond training, many participants commented there was a critical need for decision trees, metrics and milestones, and checklists. Participants stated that milestones (or sub-milestones) accompanying criteria should have different levels of project maturity, assist with informing when a project can progress to the next RL, and include program development plans and funding information (such as criteria). However, other attendees questioned if milestones could really apply to all LOs and suggested that devices developed to assist with RL assignment be discipline- and LO-specific. One participant went further to say these devices will likely need to be interpreted by each LO individually and include relevant examples. Specifically related to the development of these devices, some participants said checklists or other tools should include a review of “gates” a project needs to go through to move from one RL to another. These gates should include a clear yes or no criteria and be specific to each thing to transition. Alternatively, one participant suggested end users could have a set of requirements or goals to achieve instead of the previously mentioned checklist and decision tree ideas. Other ideas to help with RL assignment included checklist handouts and user manuals. These tools could be made available in forums where consistent understanding of RL definitions is required, such as proposal review panels. In developing any of these devices, one suggestion was to think of RL movement in terms of which bin (Research, Development, Demonstration, Deployment) a project is moving into before narrowing down selection to the specific RL. Participants also indicated that mechanisms such as workshops, training sessions, and/or printed material will be needed to improve the jargon found in the RL definitions if the definitions do not change.

## Workshop Results Specific to Things to Transition Categories

Although responses from the breakout sessions included many general comments and recommendations regarding the things to transition classification scheme (session 1) and the current RL policy (session 2), some responses (especially during session 1) were directed specifically towards the breakout group categories. The discussion below reviews responses from the post workshop survey, breakout sessions, chatroom comments (see [appendix](#)), and additional correspondence received after the workshop. Additionally, comments from the pre-workshop survey specifically directed towards one of the six categories of things to transition were included. Given the diversity of responses, this report will synthesize the main key points without providing commentary in each of the main subsections.

While session two discussions focused on general RL policy and definitions, first session breakout group results included specific changes to the existing categorical definitions and new examples to improve clarity. Some groups suggested changing the name of the actual categorical term (see below) and most groups were concerned with various overlaps between categories. Each breakout group also identified key problems with their specific category.

### Key Points from Breakout Sessions

#### *Assessments*

No explicit changes were suggested for the definition (only questions regarding word choice). However, the breakout group expressed difficulty understanding how the assessment category fit within the current RL policy and the group indicated it was very challenging to assign RLs for these types of projects. In terms of the definition and overall policy, the group questioned if RLs make sense for assessments, when they apply, how assessment RLs apply for specific concepts (such as fishery stock assessments), what the benefits are of using RLs for assessments, what the goal and intentions are of particular assessments (is it a transfer of knowledge), and what timescales (once, annually, etc.) are considered for assessment RLs. Some participants even questioned if assessments should count as something to transition, as assessments are rarely actually handed off to another organization (only the product of the assessment is handed off). From a social science perspective, attendees questioned how assessments differ from services or systems and how communication items such as story maps fit for classification. Lastly, participants commented that assessments rarely go through the same RL benchmarks as other projects (such as testbeds or proof of concepts), so the RL definitions should more explicitly include social science concepts and the synthesis of knowledge.

#### *Tools*

The breakout group indicated that RLs currently apply well to the tools category but that difficulty still persists choosing only one RL when there are often many components of a tool at different states of readiness. While the group found no problem with the definition, a main concern for participants was that the term “tool” has different connotations throughout the LOs (e.g. the National Weather Service does not consider tools to be tangible objects). The group suggested changing the categorical name, potentially to “physical tools”. Related, participants questioned the criteria to only include tangible objects in the definition and suggested that it could undo decades of precedent usage within some NOAA LOs. However, it was also recognized that intangible objects some participants thought should be listed as “tools” currently fit in the “product” category and that some lines were needed to be drawn to avoid overlap between categories. Some group members also emphasized that the definition should broaden to include things that manipulate/assess data (such as artificial intelligence software), items that help with decision making or to serve a purpose, and consider things like numerical algorithms (e.g. satellite observation retrievals), and methodologies for assimilating observations into models.

### *Products*

The breakout group primarily suggested edits to the definition and focused on general policy changes and reviewing each RL individually. Still, the group particularly worried that the definition: (1) has major overlaps with the assessment category, (2) provides no clear indication on how to handle social science products, and (3) does not address the fact that there are different levels of products (e.g. raw data, observations, and measurements presented as information products, reports, and assessments from the National Environmental Satellite, Data, and Information Service). Regarding examples, participants felt the term “model output” was not specific enough as there are many types, “model code” should be included, and that “radar-derived data” should be included, as this is a major source of NOAA data not currently under any of the categories.

### *Systems*

The main difficulty this group had was determining what projects would be considered a system. Group members also suggested the definition needs to reflect system operational components but acknowledge that not all research goes into operations. Participants stated the “systems” term appears to be a catchall that includes components from the other five category types resulting in overuse and/or overlap. Also, the many potential components of a system make classification and RL evaluation more difficult. This left some group members wondering if the category was even needed and if it may be confused with the concept of management structure. Participants urged caution with the scale of the definition and on which components should be included such that a single RL transition can be considered. Each component may have its own RL that could be tracked individually. However, some of these components may change RLs at different time-scales or never transition, complicating evaluation of the entire system. One suggested fix was to classify the system as the parent and each individual component as corresponding children.

### *Processes*

From an overall perspective, a main conclusion for this group was that the term itself should change from a plain, everyday word into something more descriptive such as “methodology”. Additionally, there were many questions about the current definition (what does “standardized” mean and should it be switched to “structured process”), requests to removing terms (“laboratory” was thought to be too limited), caution to avoid circular definitions (remove “process” from the definition), and suggestions to rearrange the writing. Some participants thought that social sciences needed better inclusion in the definition and that the definition was overly technical (one participant provided specific corrections for this in the pre-workshop survey). Finally, participants noted that processes are naturally applied and should always start at RL2. Finally, group members questioned if the method for analyzing something new constitutes a separate project (entry into NRDD) or is it a requirement inherent to the transition of a given project?

### *Services*

In general, breakout group participants felt the details in the definition were not particularly important and that some subjectivity is acceptable. Regarding RL evaluation, the group commented that it would be helpful for projects to identify their desired outcome(s), especially for services projects. However, most comments during the breakout group sessions revolved around general suggestions and recommendations for “thing” categorization and the NOAA RL system (presented in the previous report section). Still, services received a few specific comments in the pre-workshop survey. One survey taker expressed that the definition is too interconnected with products and processes. Others commented that a service can offer a piece of code to perform a repeatable task for a repeatable outcome in computing or that the definition needs to include “outsourced operations” when the project involves researching applications, effectiveness, and needs of existing technology but much of the initial technology was developed from a different entity.

## Report Conclusions

### Takeaways and Key Findings

Analysis of workshop activities and breakout group discussions revealed a diverse list of concerns, recommendations, and feedback. A number of key takeaways were identified to help maintain momentum established by the workshop.

#### 1. “Things to transition” concept is particularly difficult but potentially useful

Some participants questioned the value of having the classification system, and others thought it could greatly assist with more consistent RL assignment. Major concerns with the definitions included categorical overlap, ambiguity, verbosity, number of categories, a lack of social science focus, and that the terms have different meanings for each LO (such that additional guidance and compliance would be needed if terms used by other LOs are still desired). More specific problems were identified when analyzing the pre-workshop survey (see session one [presentation link](#)). Most participants agreed that the term “thing” needs to be changed.

#### 2. RL policy and definitions are confusing, cumbersome, and contentious

The many fundamental questions asked regarding RL policy demonstrated a high level of concern, confusion, and disagreement requiring further attention. Some of these questions asked if the RL policy should even exist or be replaced with a different method, if it is misguided to fit projects to a policy, and what the benefits are to designating specific RL values. Some participants also suggested that major changes were needed (number of RLs, multiple RL scales, etc.). Even if the overall RL policy does not undergo major changes, workshop participants still listed numerous issues they felt needed further consideration regarding RL management, planning and funding, transition plans, RL linearity and components within projects, definition interpretation, and changes to individual definitions.

#### 3. RL evaluation is still plagued with misunderstanding

Beyond RL definitions, workshop questions revealed a high persistence of misunderstanding regarding what actually constitutes a NOAA R&D effort and specific guidelines for current NOAA RL policy. On a general level, there was confusion on what type of projects actually require RL evaluation and how to follow specific RL rules (such as classifying a project by the lowest component RL). These questions indicated current policy is either unclear, unknown (or not reviewed), misunderstood, and/or unenforced. Regardless of what changes result from the workshop, it is clear that all NOAA personnel working with RL evaluation and transitions, project managers, and NOAA leadership be better informed on RL policy.

#### 4. RLs are generally found to be useful for various reasons

Nearly 75% of pre-workshop survey takers indicated the use of RLs has many benefits to their work such as progress tracking and reporting, decision making, program management, grant writing/reviewing and funding, and research outreach and education. This result clearly indicates the strong need to ensure the policy is clear, consistent, and fully adopted by all of NOAA.

#### 5. One method/policy may not satisfy all LOs; be consistent for all R&D efforts

Discussions clearly indicated that there would always be disagreement with the ultimate policy and that it will be difficult to apply one metric for all types of NOAA R&D efforts. This results from the diverse NOAA R&D portfolio and divergent policies and precedents between LOs. However, participants acknowledged that institutional policies rarely receive full personnel endorsement. Leadership must determine if the policy is needed and then ensure/enforce the use and application of a consistent NOAA-wide policy.

### Successes, Challenges, and Improvements

Participants, organizers, and the LOTMC overall found the 2020 NOAA Readiness Levels Workshop extremely successful. Over 70% of the 17 participants who took the post-workshop survey were slightly or very satisfied with the workshop content ([Figure 4](#)). One of the biggest workshop challenges was switching to a virtual format with a shortened schedule. Still, more than 80% of the post-workshop survey takers were slightly or very satisfied with the workshop from a coordination and technical perspective ([Figure 4](#)). Feedback also indicated most participants found the workshop worked well in a virtual format and that the virtual breakout sessions were successful ([Figure 4](#)). While survey takers commented how much they appreciated maximizing time by having small groups and the opportunity to voice their concerns, participants still felt the biggest challenge with the breakout group sessions was the limited time available. Future improvements suggested in the post-workshop survey included allowing participants to speak at multiple breakout groups, having more LO participation for the main presentations, providing additional time for discussions after the main sessions, allowing for more time specifically to brainstorm usable deliverables, focusing more on executing the NAO, and including PIs. More details regarding challenges and methods for switching to a virtual format which may assist future NOAA virtual workshop planning are provided in the [appendix](#).

Overall, the workshop succeeded in facilitating critical groundwork for achieving the main goal of improving NOAA RL and transition understanding. Workshop presentations, material, and discussions also brought up or revived attention on important project transition issues to key NOAA personnel and leadership that need to be addressed, informed NOAA management that there may be more problems and concerns with RL policy than previously known, and helped to brainstorm practical solutions for improvement. Post-workshop survey takers indicated they appreciated the opportunity to hear from all LOs and understand the broader issues. While key objects and deliverables such as providing a forum to discuss RL assignment, usage, and definitions, and establishing a plan for moving forward were achieved, other objectives were not. This highlights the large challenge for workshop planning to provide enough methods and allocate adequate time for participants to express their opinions and insight while still guiding the workshop towards achieving the pre-defined workshop objectives.

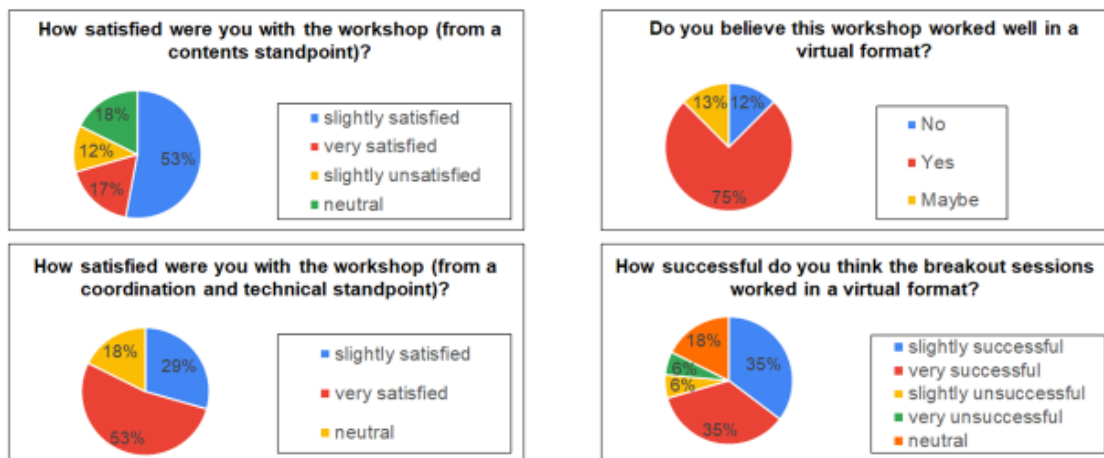


Figure 4. Results of the pro-workshop survey taken by 17 participants, indicating their level of satisfaction with the workshop and breakout sessions.

## Next Steps

Using the diverse feedback provided through various workshop-generated documents and discussions, the LOTMC will decide how best to meet the needs of NOAA regarding updates, improvements, and/or clarifications to current RL policy. The first task for LOTMC will entail deciding on a general plan to move forward with the categorization concept and how to handle RL definitions, policy, and potential deliverables (tables below). In the future, the LOTMC may consider other actions such as hosting follow-up RL workshops and/or a project transitions and transition plan workshop.

Step 1: Decide on plan for “things” categories	
Option 1:	Edit definitions, add examples, and use for RL clarification based on feedback from the workshop. Formally adopt categories (with definitions) in NAO and/or handbook.
Option 2:	Change the number of categories (then back to Option 1) or opt out of categorization.

Step 2: Decide on plan for Readiness Level definitions and deliverables	
Option 1:	Generate deliverables (checklists, milestones and decision trees, examples, etc.) for each category (if they are kept) using feedback from the workshop. This option constitutes the original proposed plan discussed during session 3 of the workshop.
Option 2:	Change definitions (handbook and/or NAO), number of RLs or sets of RLs, and/or policy and procedures based on workshop feedback then proceed with option 1.
Option 3:	Leave definitions, policies, and procedures in NAO intact but update the handbook. Then proceed to option 1.

## Recommendations from the LOTMC to Taskforce

After selecting one of the recommended options for each step outlined in the previous section of this report (or opting for a different path), the LOTMC will inform the RL Taskforce of their decision and the expected timeframe for execution. Prior to the LOTMC's decision, the following plan is recommended for the RL Taskforce:

**Part 1:** Review workshop report (draft) and notes from surveys, breakout groups, and other material; propose plan for moving forward and for creating deliverables (if suggested), make recommendations for NAO 216-105B and Handbook modifications

**Part 2:** Create final deliverables, such as summary materials and updates to the NAO 216-105B and Handbook, with regular updates to the LOTMC



## Appendix

### Workshop Agenda

<b>Time (EDT)</b>	<b>Objectives and Activities</b>	<b>Moderator(s)</b>
11:00-11:35	<b>Introduction</b> <ul style="list-style-type: none"> <li>Background, workshop objectives, and deliverables</li> <li>Schedule, format, and decorum</li> </ul>	Gary Matlock Abigail Furnish
11:35-11:40	<b>Break</b>	
11:40-13:00	<b>Session 1 - Categories of Things* to Be Transitioned</b> <ul style="list-style-type: none"> <li>History and current definitions of six things* to be transitioned</li> <li>Relevant pre-work survey responses for definition changes/examples</li> <li>Breakout into six pre-assigned groups by things* to discuss challenges, examples, and/or changes to “things” definitions</li> <li>Breakout group results and overlaps (<b>Regroup</b>)</li> </ul>	Gary Matlock David Weinstein Facilitators  Abigail Furnish
13:00-14:00	<b>Lunch Break</b>	
14:00-15:55	<b>Session 2 - RL Definitions and Challenges</b> <ul style="list-style-type: none"> <li>RL system, history, and definitions (especially RL 8-9)</li> <li>Difficulties with understanding/complying with current RLs (consider knowledge and technology perspective) from pre-work survey</li> <li>Breakout into six pre-assigned groups by things* to discuss challenges with RL system (including specific RL values), methods for improving use/understanding, and suggestions for developing deliverables</li> <li>Breakout group results and challenges (<b>Regroup</b>)</li> </ul>	Gary Matlock David Weinstein Facilitators  Abigail Furnish
15:55-16:00	<b>Break</b>	
16:00-16:20	<b>Session 3 - Final Product Plans and Next Steps</b> <ul style="list-style-type: none"> <li>Discuss plans for workshop report and ask for 1-2 volunteers per breakout group to join a follow-up work group to produce deliverables</li> <li>Review logistics of addendum to NAO, obtaining RC approval, and creation/dissemination of NOAA RL/transitions training module</li> </ul>	Gary Matlock  Gary Matlock
16:20-16:30	<b>Wrap Up and Closing Remarks</b>	Gary Matlock

\*system, process, service, tool, product, or assessment



## Virtual Workshop Information

Due to health considerations and mandatory mass telework resulting from COVID-19, the LOTMC moved the RL Workshop to a virtual format on the platform Google Meet. The schedule of the meeting was condensed to accommodate different time zones of participants. Given the compressed schedule, the pre-workshop survey played an important role in providing input that informed the planning and presentation materials. Break out groups were retained to foster additional discussions that would not be possible in the larger group setting. The chat function of the meeting platform was also used to engage participants. Overall, the switch to a virtual workshop was viewed as successful, as indicated by the 75% of post-workshop survey responses that indicated “Yes” to the question “Do you believe this workshop worked well in a virtual format?”

### Attendee List

Of the 68 originally invited guests, 49 RSVPed that they would be attending the workshop. In addition, there were 3 attendees that were not on the original list, and 2 attendees participated periodically and not included as “yes” responses. A full list of RL Workshop attendees, including their Line Offices and assigned break out groups, can be found [here](#).

### Workshop Hyperlinks (including session recordings)

Presentations included the [Introduction](#), [Session 1 - Categories of Things to Be Transitioned](#), [Session 2 - RL Definitions and Challenges](#), and [Session 3 - Final Product Plans and Next Steps](#). The full recording of the 2020 RL Workshop can be found [here](#).

### Main Session Chatroom Log

The full list of comments from the webinar chat box can be found [here](#).

### Pre and Post-Workshop Surveys

The pre-workshop survey can be found at [this link](#) and the post-workshop survey questions may be viewed [here](#).

### Transition Matrix

The LOTMC created a [transition matrix](#) with example projects from each Line Office. These examples were used to inform discussions and content for the RL Workshop.

## Acknowledgements

### Workshop Coordinator

David Weinstein

NOAA OAR/CollabraLink Technologies, Inc

### Primary Workshop Facilitator

Abigail Furnish

NOAA NMFS

### Breakout group facilitators (Office of Science Support)

Gina Digiantonio (*Processes*)

NOAA OAR/CollabraLink Technologies, Inc

Shanie Gal-Edd (*Tools*)

NOAA OAR/CollabraLink Technologies, Inc

Emma Kelley (*Services*)

NOAA OAR/CollabraLink Technologies, Inc

Meka Laster (*Assessments*)

NOAA OAR

Laura Newcomb (*Systems*)

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Kristen Schepel (*Products*)

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