

Fisheries Information Management Modernization Workshop

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U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

NOAA Technical Memorandum NMFS-F/SPO-204
September 2020

Fisheries Information Management Modernization Workshop

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August 2020

NOAA Technical Memorandum NMFS-F/SPO-204

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Recommended citation:

Margolis, S., Lowther, A., Peterson, L., Schwing, F., Sender, K. 2020. Fisheries Information Management Modernization Workshop. NOAA Tech. Memo. NMFS-F/SPO-204, 85 p.

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Acknowledgments

The NOAA Fisheries Information Management Modernization (FIMM) Workshop was made possible by the collective planning and expertise of an inter-agency team: Frank Schwing (NMFS OST), Alan Lowther (NMFS OST), Karen Sender (NMFS OST), Lisa Peterson (contractor in support of NMFS OST), Bill Michaels (NMFS OST), Paul Kostovick (NMFS NEFSC), Kate Wing (Intertidal Agency), Todd Hay (NMFS NWFSC), Mike Cahall (ACCSP), and its organizer, Sarah Margolis (contractor in support of NMFS OST).

Thank you to the Workshop speakers and panelists for providing critical background on information management (IM) drivers, and what's currently going on with IM within the agency and with its partners: Mike Cahall (ACCSP), Tyler Christensen (NOS), Julie Defilippi Simpson (ACCSP), Jon Hare (NEFSC), Ed Kearns (NOAA CDO), Patrick Lynch (NMFS OST), Mashkoor Malik (OAR), Rost Parsons (NOAA NODC), Bob Ryznar (PSMFC), Jessica Stephen (NMFS SERO), Jordan Watson (NMFS AFSC), and Geoff White (ACCSP).

The Workshop facilitators helped guide fruitful, comprehensive, and focused discussion on NMFS information management modernization. Thank you to Makeda Okolo (NOAA USEC), Julia Royster (NMFS OHC), Hernan Garcia (NESDIS).

Many thanks to the note takers who captured discussions from panels and breakout groups: Katherine Wilson (NMFS NWFSC), Noelle Olsen (contractor in support of NMFS OST), Andie Chan (contractor in support of NMFS OST), Sam Chin, (NOAA SeaGrant Fellow), and Zuzy Abdala (NOAA SeaGrant Fellow).

In addition to all mentioned above, the Workshop was successful due to the knowledge and participation of national experts representing all science centers, regional offices, and key inter-agency partners in national fisheries information processes.

A special thank you to the NOAA FIMM Workshop participants who drafted the recommendations from this report: Adele Irwin (NMFS OP), Ajith Abraham (NMFS AFSC), Alan Lowther (NMFS OST), Brad Gough (NMFS PIFSC), Brett Alger (NMFS OST), Diana Ma (NMFS OCIO), Frances Tong (NOAA PIFSC/JIMAR), Frank Schwing (NMFS OST), Jessica Stephen (NMFS SERO), Jihong Dai (contractor in support of NMFS OST), Jordan Watson (NMFS AKSC), Joshua Lee (NMFS PIRO), Karen Sender (NMFS OST), Keith Hagg (NMFS GC), Kevin Schulke (NOAA OCIO), Lanora Vasquez (NMFS SWFSC), Lynn Dewitt (NMFS SWFSC), Paul Kostovick (NMFS NEFSC), Bob Ryznar (PSMFC), Samir Mehti (NOAA OCIO), Bill Michaels (NMFS OST), Sarah Dunsford (NOAA OCIO), Steve Lewis (NMFS AFSC), Thomas Robertson (NMFS SERO), Tim Haverland (NMFS OST), Torey Adler (NMFS GARFO), Tyler Christensen (NOS).

Additional travel and logistical support was provided by the NMFS Office of Science and Technology and the [Fisheries Information System Program](#).

Glossary (definitions based on citation noted in parentheses)

Data: Facts that are represented as text, numbers, graphics, images, sound, or video. Data is the raw material used to represent information, or from which information can be derived. Individual facts that are out of context, and have no meaning by themselves are often referred to as raw data (The DAMA Dictionary of Data Management, 2nd Edition; Earley, 2011).

Data Lifecycle: A conceptualization of how data is created and used which attempts to define a “birth-to-death” value chain for data, including acquisition, storage and maintenance, use, movement, archive, and destruction (The DAMA Dictionary of Data Management).

Data Management (DM): The business function that develops and executes plans, policies, practices and projects that acquire, control, protect, deliver, and enhance the value of data (The DAMA Dictionary of Data Management).

Data Maturity Framework: A model that provides guidance to assist organizations in assessing data programs and defining goals (The DAMA Dictionary of Data Management).

Data Governance: The exercise of authority, control, and shared decision-making (planning, monitoring, and enforcement) over the management of data assets (The DAMA Dictionary of Data Management).

Data Steward: A business leader or subject matter expert designated as accountable for: a. The identification of operational and business intelligence data requirements within an assigned subject area, b. The quality of data names, business definitions, data integrity rules, and domain values within an assigned subject area, c. Compliance with regulatory requirements and conformance to internal data policies and data standards, d. Application of appropriate security controls, e. Analyzing and improving data quality, and f. Identifying and resolving data-related issues (The DAMA Dictionary of Data Management).

Data Stewardship: The formal, specifically assigned, and entrusted accountability for business (non-technical) responsibilities ensuring effective control and use of data and information resources (The DAMA Dictionary of Data Management).

Information: The interpretation of data based on its context including: a. The business meaning of data elements and related terms b. The format in which the data is presented c.

The time represented by the data d . The relevance of the data to a given usage (The DAMA Dictionary of Data Management).

Information Consumer: A person or group that receives data and uses it to create information. A more descriptive term for a data consumer, since the consumer creates and uses information by interpreting data in context (The DAMA Dictionary of Data Management).

Information Management (IM): The management of data in context, with relevance and timeframes for business benefit (The DAMA Dictionary of Data Management).

Information Lifecycle Management: An approach to manage the flow of a system's information from creation through usage to purge (The DAMA Dictionary of Data Management).

Information Technology (IT): A broad subject concerned with technology and other aspects of managing and processing information especially in organizations. IT deals with the use of electronic computers and computer software to convert, store, protect, process, transmit, and retrieve information. Also the department of an organization that deals with computer hardware, application software systems, and data. (The DAMA Dictionary of Data Management).

Fishery-Dependent Data: Data that are collected directly from commercial and recreational fisheries. Types of information may include fishing effort, total amount of fish removed from the ocean (landings and discards), species (target and incidental), and biological information. Fishery dependent data may be collected through use of dockside monitors, at-sea observers, logbooks, electronic monitoring and reporting systems, telephone surveys, and vessel-monitoring surveys (NMFS OST).

Fishery-Independent Data: Data that are collected from at-sea surveys where scientists from NMFS science centers and partner agencies/institutes gather information on fish stock abundance, biology, and their ecosystem for inclusion in stock assessments (NMFS OST).

Fisheries Information Management: The end-to-end infrastructure and processes for fisheries data and information that includes acquisition, storage and maintenance, use, movement, archive, dissemination, and destruction (The DAMA Dictionary of Data Management).

List of Acronyms in Report

ACCSP- Atlantic Coastal Cooperative Statistics Program
AD- Applications Developer
AI- Artificial Intelligence
AIS- Automatic Identification System
CDSP- Cloud Data Science Platform
DG- Data Governance
DGC- Data Governance Committee
DGIT- Data Governance Implementation Team
DMMM- Data Management Maturity Matrix
DMP-PD- Data Management Planning Procedural Directive
EDM- Enterprise Data Management
EO- Executive Order
ERDDAP- Environmental Research Division's Data Access Program
FACA- Federal Advisory Committee Act
FDS- Federal Data Strategy
FIMAC- Fisheries Information Management Advisory Committee
FIMM- Fisheries Information Management Modernization
FINs- Fishery Information Networks
FIS- Fisheries Information System
FMC- Financial Management Center
FTE- Full-Time Equivalent
GDA-Geospatial Data Act
GAO- Government Accountability Office
HR- Human Resource
HVD- High-Volume Data
IM- Information Management
IMPCT- Information Management Policy Coordination Team
IA- Information Architect
IT- Information Technology
MSA- Magnuson-Stevens Act
NMFS- The National Marine Fisheries Service
NESDIS- National Environmental Satellite, Data, and Information Service
NOS- National Ocean Service
NOSC- NOAA Observing Systems Council
OCIO- Office of the Chief Information Officer
OHCP- Office of Human Capital Services

OMB- Office of Management and Budget

OPM- Office of Personnel Management

OST- Office of Science and Technology

OTKM- Office of Training and Knowledge Management

PARR- Public Access to Research Results

PM- Project Management

PMT- Program Management Team

PMST- Project Management Standards and Guidelines Development Team

PSG- Professional Specialty Group

SDD- Software Design and Development

SERO- Southeast Regional Office

Executive Summary

Modernized workflows yield more timely and accurate science and data products by improving processing efficiencies, partnership and stakeholder communications, and data accessibility and dissemination. To prepare the NOAA National Marine Fisheries Service (NMFS) for the modernization of its Information Management (IM) systems, the NMFS Office of Science and Technology (OST) conducted a Fisheries Information Management Modernization (FIMM) Workshop in Silver Spring, MD, on September 17-19, 2019. The purpose of the FIMM Workshop was to review and evaluate practical and tangible actions to modernize the data and information system of NMFS, the Fishery Information Networks (FINs), and other partners that provide, process, and use fisheries data. This Workshop was a crucial and successful response to [recommendations](#) from the Net Gains Alliance, a global initiative committed to accelerating the modernization, implementation, and adaptation of robust information systems to support sustainable management of ocean resources, suggesting NMFS develop a strategy for modernizing the nation's fisheries IM system. It also was an important step in addressing many legislative and administrative requirements.¹

The FIMM Workshop brought together more than 75 subject experts, managers, and administrators in information technology and information management from all stages of the data lifecycle. The majority of the participants were from the NMFS Science Centers and Regional Offices (all Centers and Offices were represented), as well as individuals involved in the IM process from NMFS HQ and other NOAA line offices, state partners, the FINs, and other organizations. The IM modernization efforts considered in this Workshop included the integration and streamlining of NMFS fishery-dependent and fishery-independent data and information, and the information flow processes of all NMFS fishery, environmental, and socioeconomic data.

Prior to the Workshop, NMFS OST conducted a data call to identify current modernization initiatives and to understand regional and national IM priorities. The responses of 140 individuals from NMFS HQ offices, all Science Centers, Regional Offices, and NMFS partners, which were summarized and presented at the Workshop.

Three national conference calls also were held to discuss the technological, governance, and

¹ NMFS is engaged in many activities responding to national and regional authorities and drivers for modernizing its fishery information management systems. Modernizing data and information management has been identified as a national priority by several agency and government-wide drivers, including the 2019 NMFS Priorities and Annual Guidance, DOC Strategic Plan, Federal Data Strategy, and Federal Evidence-based Policymaking Act.

personnel aspects of modernization with about 30-40 participants across NMFS and its stakeholders on each call. The data call and conference calls informed the final structure and organization of the Workshop.

On the first two days of the FIMM Workshop, subject expert speakers and panelists provided: background on our existing IM systems and its science and management drivers; perspectives from data providers, users, and partnerships; and case studies and lessons learned across the NOAA Enterprise. Participants then met in plenary and breakout sessions to review the fishery data and information ecosystem, and discuss practical and incremental steps toward modernization. The Workshop was a free sharing of technical information and ideas from individuals within NMFS, its IM partners, and those providing and using fishery data.

The third day was a closed session where NOAA employees and contractors recapped the Workshop and came to consensus on modernization goals based on the broader discussions and exchanges with our partners. These NOAA IM subject experts applied their diverse expertise and perspectives to identify recommendations to address the main challenges discussed prior to and at the Workshop. The final drafting of individual recommendations was completed by NOAA writing teams after the Workshop.

Input garnered from the FIMM Workshop's participants was compiled and used by NMFS staff to draft this Technical Memorandum for NMFS leadership. It recommends a set of tangible and cost-effective actions that will enhance the modernization of the Fisheries IM system. This report identifies specific modernization actions, who will do them, what resources will be required, and a timeline for their completion. NMFS will develop and report metrics to measure the impacts of actions resulting from the Workshop's recommendations. With the support of NMFS leadership and in concert with its partners, NMFS national and regional IM teams will schedule and carry out these actions. They will also develop a long-term strategy for evaluating and prioritizing modernization of the end-to-end Fisheries IM system.

Some of the conclusions of the Workshop included:

- FIMM Workshop participants strongly agreed that data is one of NMFS' most important assets and requires adequate infrastructure, technology, staffing, and governance to support it.
- Communication is crucial for IM modernization. A community of experts needs to be established to create a framework for communicating between data providers,

processors, and users, and to share how technologies are implemented and issues addressed.

- A commitment to adequate and sustained IM resources is critical. Prioritizing permanent funding for technology, infrastructure, and personnel will unlock data resources, create efficiencies, and streamline data flow and access, leading to reduced costs in maintaining and properly executing IM.
- Partnerships have been, and will continue to be, essential to successful fisheries information management. NMFS must cooperate and collaborate with its partners within NOAA and the Federal government, industry, NGOs, and academia, to share knowledge and tools, apply best practices, leverage capabilities, streamline data discovery and access, transfer successes, and learn from experiences.
- Better coordination within NMFS and with our data partners will take advantage of agency and partner specialists and expertise, strengthen important relationships, reduce duplication of effort, and allow for efficient and cost-effective allocation and use of IM resources.
- Sustained commitment and support from NMFS and NOAA leadership is required to successfully modernize the NMFS IM system. Leadership can communicate the importance of this modernization strategy to ensure that all parts of the agency have a shared vision and commitment. Strong support will be crucial to overcoming cultural and technical obstacles.

List of Workshop Recommendations

Data and Information Governance

Recommendation 1: Plan and implement a NMFS Data Governance Framework.

Recommendation 2: Develop a NMFS Information Management Plan for high-volume data systems.

Recommendation 3: Adopt and implement a NMFS Data Management Maturity Matrix tool.

Policies and Procedures

Recommendation 4: Establish a coordinated process to develop and review the legal, technical, policy, and governance aspects of NMFS information management policies.

Recommendation 5: Update the NMFS Data Management Planning Procedural Directive to include regular data architecture revisions.

Recommendation 6: Develop and adopt Program and Project Management Standards and Guidelines for information and technology projects.

Personnel and Human Resources

Recommendation 7: Modernize and expand the NMFS Information Management Workforce.

Recommendation 8: Establish a NMFS Software Design and Development Professional Specialty Group.

Technology

Recommendation 9: Implement a NMFS-wide cloud-based data science, management, and publishing platform (the Cloud Data Science Platform).

Recommendation 10: Develop NMFS guidance for the adoption and use of software project and performance management tools.

1. Introduction

1.1 Background

The Fisheries Information Management Modernization (FIMM) Workshop described in this Technical Memorandum addressed a wide array of requirements and initiatives to improve fisheries data management. It was a major step in defining NOAA's response to Federal statutory² and regulatory³ drivers that address modern stewardship and advancement of the public's data.

The Evidence Act and the Federal Data Strategy codify how US Government agencies will manage and leverage data as an asset. According to the Evidence Act, all Federal data assets are to be: open by default (subject to legal exemptions); distributed under an open license; and published in machine-readable format. To accomplish this, each agency is mandated to: maintain a comprehensive data inventory; establish data governance structures; and publish an Information Resource Strategy, which includes an Open Data Plan. The action-based recommendations framed by the Workshop address many of these legal mandates.

The Workshop also was responsive to NOAA's five science and technology focus areas: [Unmanned Systems](#), [Artificial Intelligence \(AI\)](#), [Cloud Computing](#), ['Omics](#), and [Data](#) (Figure 1). The Data and Cloud Computing Strategies have their own broad application across the agency while underpinning and enabling information management in support of the other three NOAA focus area strategies.

In addition, a 2019 [report](#) from the Government Accountability Office (GAO) on Information Technology recommends US Federal agencies fully implement eight key IT workforce planning activities. These include setting a strategic direction for IT workforce planning, identifying IT workforce skill gaps, developing strategies and implementing activities to address skill gaps, and monitoring their progress. The [Net Gains Alliance](#), a non-partisan initiative to modernize global fisheries and ocean information systems, released a report in 2017 suggesting steps for the NOAA National Marine Fisheries Service (NMFS) to improve its data management.

² e.g., [Foundations for Evidence-Based Policymaking Act](#) (Evidence Act), [Geospatial Data Act](#) (GDA)

³ e.g., [Federal Data Strategy](#) and [Action Plan, Executive Order](#) (EO) on Maintaining Executive Leadership in Artificial Intelligence (AI)



Figure 1. NOAA’s five science and technology focus area strategies: Cloud Computing, Data, Unmanned Systems, Artificial Intelligence, and ‘Omics.

To prepare NMFS to respond to these multiple drivers in a coordinated and strategic way, the NMFS Office of Science and Technology (OST) conducted the FIMM Workshop in Silver Spring, MD, on September 17-19, 2019. The purpose of the Workshop was to review and evaluate practical and tangible actions to modernize the data and information systems that are used by and connect NMFS, the Fishery Information Networks (FINs), and other partners that provide, process, and use fisheries data.

1.2 Foundation for NMFS IM Modernization: Challenges and Successes

To enhance the planning of the FIMM Workshop, OST administered a data call across NMFS and its partners that identified current efforts, challenges, gaps, and recommendations for fisheries information management systems and processes. By answering quantitative and

qualitative questions, data call recipients provided input on their region's, center's, organization's, etc. execution of certain aspects of modernization, in addition to their individual modernization priorities.

Results were broken down and compared by type of respondent (based on their answers to the data call): data **producers**, **processors**, and **consumers**; **NOAA** vs. **NOAA partner**; and those primarily working with **fishery-dependent** data vs. **fishery independent** data. See Appendix B for all data call results.

What does modernization mean to you?



Figure 2. Word cloud of responses from data call recipients answering, “What does modernization mean to you?”

The figures below from the data call show the responses of all data call recipients when asked to rate aspects of modernization in the context of data production (Figure 3), processing (Figure 4), and consumption (Figure 5) at their organization with the following scale: **(0= No opinion, 1= Poor 2= Fair 3= Good 4= Excellent)**. The figures below show the proportion of ‘positive responses’, i.e. those who chose ‘good’ or ‘excellent’.

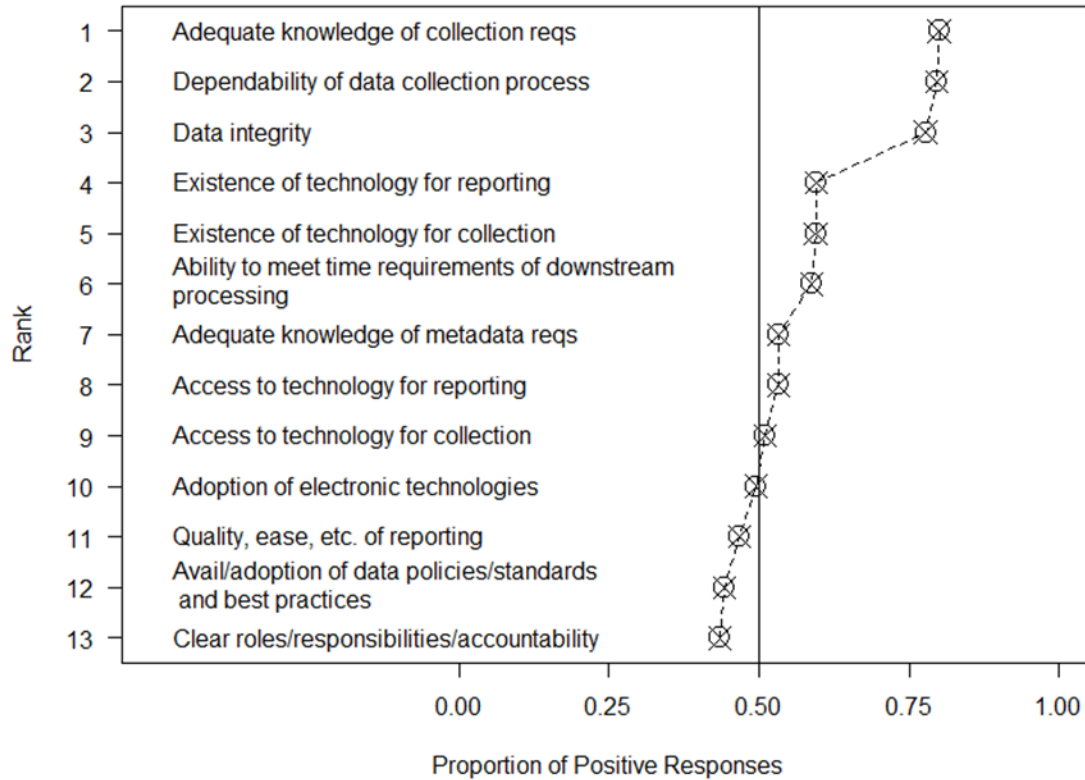


Figure 3. The proportions of aggregated positive responses regarding aspects of information management at respondent's organization in the context of data production. This graph shows a higher proportion of positive responses for adequate knowledge of collection requirements, the dependability of data collection and integrity of the data. In contrast, the figure shows a lower proportion of positive responses for easy, quality reporting, effective use and communication of available data policies/standards/best practices, and clear personnel roles/responsibilities/accountability.

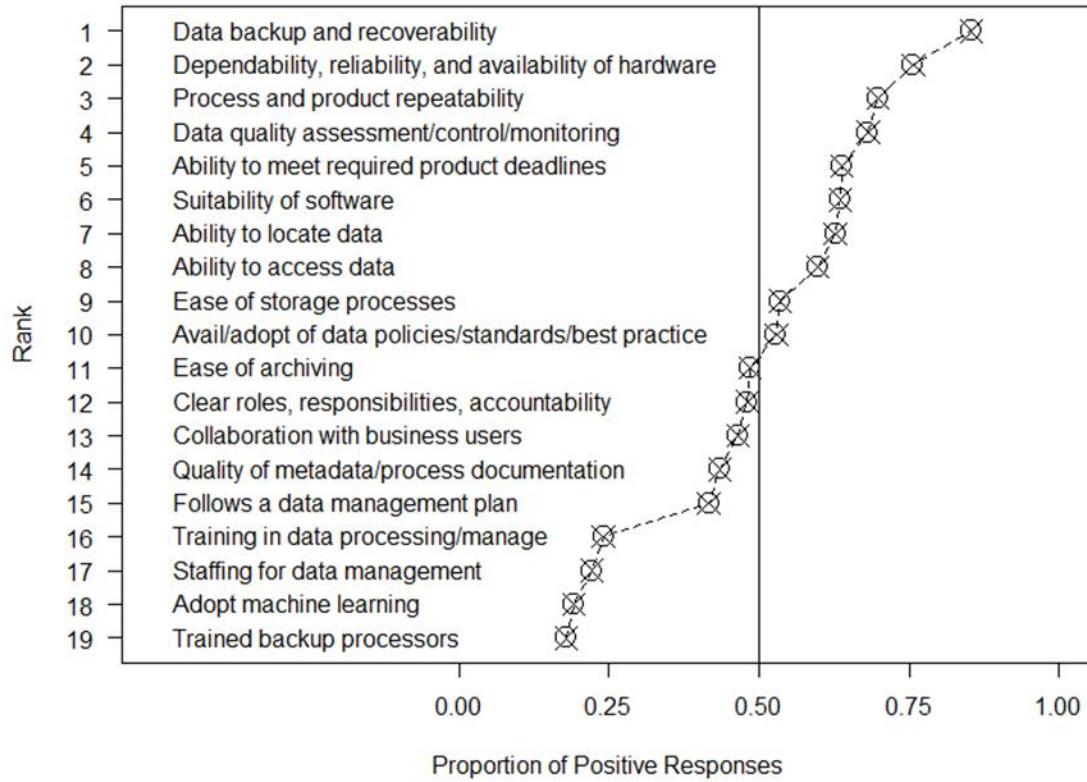


Figure 4. The proportions of aggregated positive responses regarding aspects of information management at respondent's organization in the context of data processing. Data backup and recoverability has the highest amount of positive responses. Three of the four aspects with the fewest amount of positive responses are related to staff and personnel.

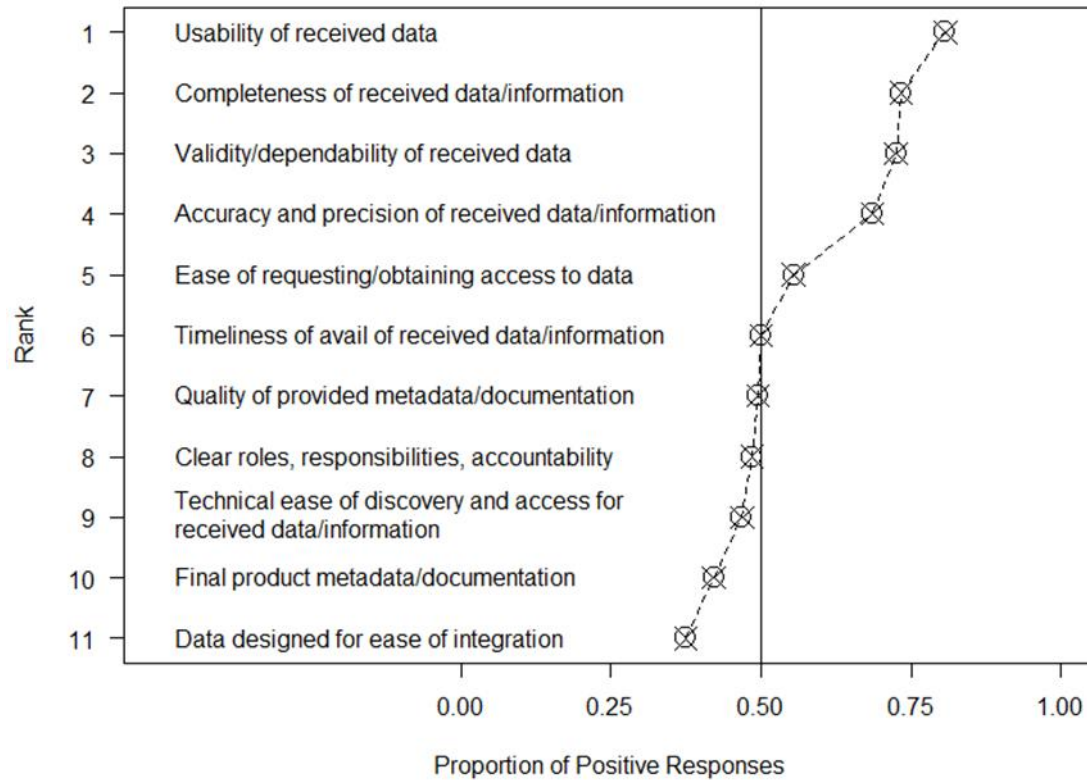


Figure 5. The proportions of aggregated positive responses regarding aspects of information management at respondent's organization in the context of data consumption. Responses show the data is usable, complete and dependable; however, the data is not easily discoverable or accessible, properly documented, nor designed for ease of integration.

In addition to the data call, three national conference calls of 30-40 participants each were held prior to the Workshop. Discussions from these calls began categorizing modernization needs into distinct areas of focus: 1) Data and Information Governance; 2) Policies and Procedures; 3) Personnel and Human Resources; and 4) Technology. **Data and Information Governance** focuses on the overall management of the availability, usability, and integrity of data. **Policies and Procedures** pertains to developing and implementing policies that enable modernization through enhancing communication and sharing best practices. **Personnel and Human Resources** covers training, identifying gaps in skills and knowledge, and communication of information and skills. **Technology** considers physical hardware, data pipelines, cloud services, etc.

Participants on these calls discussed modernization topics such as data ownership, the need for integration, standardization (national vs. regional), more effective communications avenues, partnerships, the IT and data workforce, and stronger yet agile governance.

1.3 FIMM Workshop Goals and Scope

The scope of the FIMM Workshop was to review priorities for modernizing the fisheries information management ecosystem of NMFS, its state partners, the Fishery Information Networks, and other organizations. The perspective of the Workshop focused on high-level components of the IM lifecycle (collection, processing, stewardship, distribution, and disposition) (Figure 6), including the flow of data from local to national repositories (Figure 7).

The goal of the Workshop was to identify and build consensus on fishery information management challenges (data governance, organizational and technical architecture, resources, processes, reporting, etc.) and develop recommendations to NMFS leadership to strategically modernize fisheries information management to ensure timely, reliable access of NMFS fishery, environmental, and socioeconomic information for its users.

The Workshop was a free sharing of technical information and ideas from individuals within NMFS, its IM partners, and those providing and using fishery data. Federal Advisory Committee Act (FACA) rules were not applicable. The Workshop was an invitational event but open for public attendance, and designed to elicit individual views and suggestions from data providers and users. Input during the Workshop was taken as general comments and suggestions rather than formal recommendations, and considered in subsequent discussions by NOAA staff in developing further recommendations and actions. There was no expectation of reaching consensus on topics of discussion. In the spirit of transparency and trust, attendees may use information from the Workshop's presentations, panels, and discussions, but may not attribute any comments to individual participants.

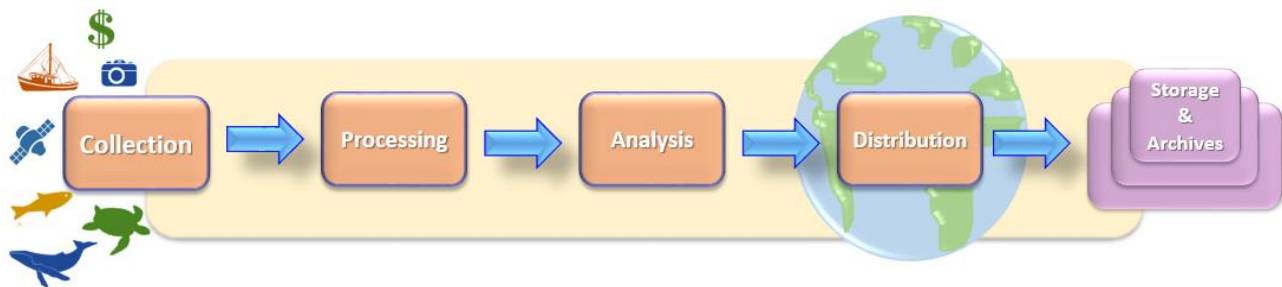


Figure 6. A simplified representation of the information management lifecycle.

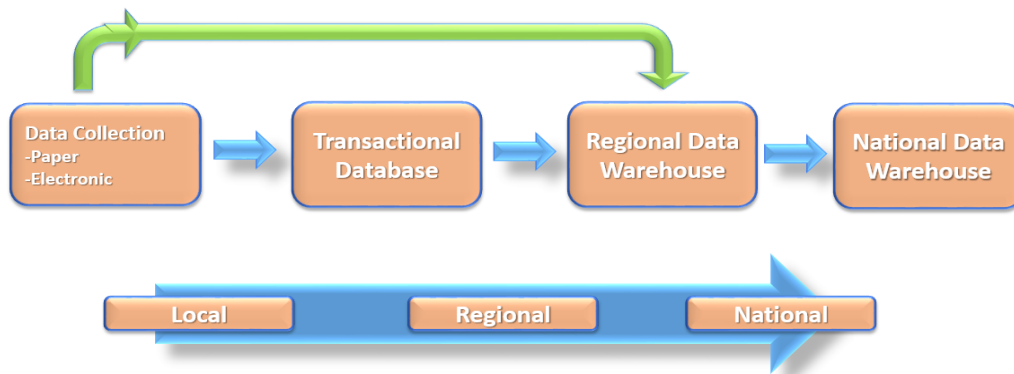


Figure 7. The flow of data from local to national repositories.

2. Meeting Overview

The FIMM Workshop brought together more than 75 subject experts in information technology from all stages of the data lifecycle: collection, processing, stewardship, distribution, and disposition. The majority of the participants were from the NMFS Science Centers and Regional Offices (all Centers and Offices were represented). The remaining participants included individuals involved in the IM process from NMFS HQ, NOAA National Environmental Satellite, Data, and Information Service (NESDIS), NOAA National Ocean Service (NOS), and other NOAA line offices, state partners, FINs, and other organizations.

The keynote presentation was given by Dr. Jon Hare, the Science and Research Director at the NMFS Northeast Fisheries Science Center. He shared the following ten focal points for NMFS to consider for modernization efforts and helped set the tone of the discussions during the Workshop:

1. Understand basic IM infrastructure
2. Share modernization successes and solutions across NMFS
3. Include our data collectors, users, partners, and stakeholders in conversations
4. Learn from others, both nationally and internationally
5. Understand how to leverage strengths across NMFS, our partners and third parties
6. Support data confidentiality
7. Design for local, regional, and national levels, and identify the commonalities
8. Centralize data and data streams where useful
9. Keep future data uses in mind (e.g., open access, well documented metadata)

10. Consider the sustainability of management, resources and people.

On the first two days of the FIMM Workshop, subject expert speakers and panelists provided background on the science and management drivers for modernization and shared perspectives from across a diverse set of roles within the data lifecycle. Participants also met in breakout sessions to review NOAA fishery data and information management processes and discuss practical steps toward modernization. This section summarizes the Workshop presentations and discussions from the plenary, panel, and breakout sessions. Speaker presentations are available through the links in the following sections. Speaker abstracts and biographies are in Appendix D and E respectively.



Figure 8. FIMM Workshop participants in the Civic Building in Silver Spring, MD on September 17, 2019.



Figure 9. NMFS staff and affiliates during the last morning of the FIMM Workshop on September 19, 2019.

2.1 Science and Management Drivers

Science and management drive NMFS' mission to steward productive and sustainable fisheries, contribute to safe sources of seafood, enable the recovery and conservation of protected resources, and promote healthy ecosystems. Modernized information flows will enhance the timeliness and accuracy of both science products and management decisions.

Patrick Lynch, NMFS OST Assessment and Monitoring Division Director, spoke about modernization in regard to the [science drivers](#) for NOAA's mission. The talk highlighted the link between modernization and the enhanced timeliness, thoroughness, and transparency of stock assessments. It also summarized the results of a questionnaire distributed to stock assessment scientists across all NMFS science centers. Information management, and the efficiency by which scientists can develop advice, varies substantially across regions, in part due to external factors (e.g., the number of contributing partners). In some regions, data acquisition and processing require the majority of an analyst's time, whereas more streamlined systems offer more time for developing advice and advancing the science. NMFS has a proven track record of supporting sustainable fisheries management. Through comprehensive monitoring, research, and stock assessment analyses, NMFS is able to provide high-quality scientific advice to fishery managers that helps to fulfill legal mandates and facilitate sustainable fisheries. However, challenges regarding data management can

serve as a bottleneck within the science advisory process that limits efficiency. These limitations are not trivial, as the management needs for scientific advice far exceed NMFS scientific capacity. However, improvements to information management could help to better meet those needs. There is clearly a need for information modernization to support stock assessments and science advisory processes, and efforts are underway across regions. However, should additional resources become available, regions with the least efficient frameworks may represent the highest priorities for investment.

Jessica Stephen, NMFS Southeast Regional Fisheries Office Limited Access Privilege Program and Data Management Branch Manager, connected [management drivers](#) to mandates in the Magnuson-Stevens Act (MSA), including preventing and ending overfishing, rebuilding overfished stocks, and specifying annual catch limits and accountability. The Southeast Region faces challenges that could be assisted through potential electronic technologies and data modernization. The Region has the unique distinction of working with three Fishery Management Councils and 11 different states or territories. Furthermore, management faces different objectives for the large commercial and recreational fisheries. In some instances, the recreational fisheries are the primary harvesters of the fish stock. Some key factors to management decisions with respect to data modernization include improving timeliness of data collection and sharing, data quality increases through electronic technologies, reduced duplicative reports through partnership and data sharing, and the potential of at-sea data transmissions. Key modernization considerations for the Southeast Region include system maintenance, storage capacity, data access, data sharing, and program development.

2.2 Stakeholders and Partnerships

Trusted partnerships are crucial to the success of modernized information workflows and management. Many organizations and institutions share comparable missions and help facilitate the components of the IM process such as storing and disseminating data. FINs are regional cooperative state-federal programs that design, implement, and conduct marine fisheries statistics data collection programs. FINs integrate data into a single data management system that meets the needs of fishery managers, scientists, and fishermen. As such, they provide an example of best practices for managing data.

Mike Cahall, former director of the Atlantic FIN, the Atlantic Coastal Cooperative Statistics Program (ACCSP), presented on ACCSP's successful data warehouse built on the integrity of [partnerships](#) and common language of standards. ACCSP was created in 1995 to standardize fisheries data collection and management practices and provide a centralized information system to house coastal fisheries-dependent data. Since then, ACCSP has worked

collaboratively with its partners to create modern, integrated data collection systems using forward thinking and best practices. Today, ACCSP has dramatically improved the quantity, quality, accuracy, and timeliness of these data and continues to work with its partners to meet the challenges and needs of its stakeholders.

Julie Defilippi Simpson, Deputy Director of ACCSP, further demonstrated how standards are the backbone to complete and [widespread data access](#). Data consolidation and accessibility is at its core about partnerships. Standardization is the basis of data consolidation and is only achievable through a collaborative process. Interaction with and among data providers leads to standards that provide guidance and flexibility and allows for the integration of multiple data sets into a single homogenized, regional data set. Processing these data is complex and dependent upon an understanding of the data that can only come from the data providers. Process documentation and metadata are necessary throughout the process. These data must be accessible in public and confidential formats that are user-friendly. Working together with partners and FINs has been an important part of building ACCSP's online Data Warehouse.

2.3 NOAA Case Studies

Recent government initiatives have yielded opportunity and motivation for information management modernization. Ed Kearns, former NOAA and DOC Chief Data Officer, [highlighted](#) how NMFS may want to leverage these efforts. Many Federal agencies such as NOAA are attempting to modernize their approaches to how they execute their missions. Commercial cloud technologies have fallen in price and offer flexible, scalable approaches to the storage and computing needs of those agencies. However, NOAA and other Federal agencies are also facing governance and utilization challenges related to their data assets that have large implications for the adoption of new IT and science-focused technologies. To help with these challenges to enable the maximum value to be realized from Agency data assets, OMB has led the development of the [Federal Data Strategy](#). Congress passed the [Evidence Act](#) and the [Geospatial Data Act](#) in 2019, which codify many of NOAA's existing data practices and policies but also present additional opportunities. The presentation described how NMFS may want to leverage these efforts to take a strategic approach to its data challenges.

In addition to larger Federal drivers, NMFS recognizes Enterprise-wide modernization efforts as an opportunity to learn and build shared knowledge and best practices. Tyler Christensen, National Ocean Service (NOS) metadata coordinator, spoke on the [diverse data](#) coordinated through the NOS ACIO's office. NOS is an expansive line office, with a wide range of missions and data assets. Recent successes include a comprehensive data

inventory, Public Access to Research Results (PARR) assessment, migration of the metadata catalog to InPort, and some efforts to migrate to the cloud.

Within NMFS, more attention is being put on data modernization to properly handle and manage big data within the science centers and regional offices. Jordan Watson, NMFS Alaska Fisheries Science Center Mathematical Statistician, presented a case study on his work to [automate data integration](#) protocols to provide near real-time sea surface temperatures to address more timely regional management needs.

2.4 Breakout Discussion

The FIMM Workshop had a total of 11 breakout groups during its first two days. At the end of each breakout group discussion, the groups came together in plenary to report on their sessions.

The first three breakout group themes focused on three aspects of modernization: Technical and Logistical; Policy and Governance; and Personnel and Culture. Participants were pre-selected for these groups to ensure an even balance of regions and expertise.

The other eight breakout groups on Day 2 were determined by an affinity diagramming activity completed by each local Workshop participant the previous day. The activity collectively considered modernization priorities from each participant and clustered the responses in real-time to define themed groups.

Several recurring themes discussed in the breakout groups are highlighted below:

1. Integrated data streams
2. Strong project management and planning culture
3. Communication of best practices and standards for data collection and processing
4. The need to assess and modernize NMFS' information management workforce skills, resources, and infrastructure.

2.4.1 Breakout Groups: Day 1

The first day's breakout groups discussed the importance of knowing what data exists, the need for integrated data streams, clear and concise metadata, hardware and software inventory tools, and cloud-based confidential data sets. Integrated data streams will increase the accessibility of data, as well as streamline the entire flow of information. In addition to technical aspects of modernization, groups discussed the importance of

transparency in policy at the leadership, operational, and external (i.e., fishermen, cross-region) levels, and the need to have sustained NFMS leadership support for a strong national data governance framework. Other topics included the importance of encouraging a project management and planning culture, staff training in data management and communication practices, and having a solutions architect.

2.4.2 Breakout Groups: Day 2

The second day's breakout groups discussed enhancing inter- and intra-agency collaboration, internal capacity building, training and learning, and successful data governance. The groups considered aspects of IM modernization such as improving the current skills, resources, and infrastructure, and creating bottoms-up communication structures to share knowledge of project management best-practices and lessons learned. There was consensus that successful data governance would be best demonstrated by a strong regional data management governance structure coordinated by the Information Architect and a proposed Regional Data Management Coordinator that would act with the support of NMFS leadership as a mediator between regional data programs, leadership, and the broader fisheries data community.

3. Recommendations

The final day of the FIMM Workshop was a closed session where NOAA employees and contractors recapped the Workshop and came to consensus on modernization goals based on the broader discussions and exchanges with our partners. These NOAA IM subject experts applied their diverse expertise and perspectives to identify recommendations to address the main challenges discussed prior to and at the Workshop. The final drafting of individual recommendations was completed by writing teams in the weeks after the Workshop. The final versions presented here were edited for consistency.

The following section describes ten recommendations, separated into four categories identified by the pre-Workshop data call (Appendix B) and conference calls: 1) Data and Information Governance; 2) Policies and Procedures; 3) Personnel and Human Resources; and 4) Technology.

The recommendations will provide sound data governance and accountability, coordinate the development and adoption of IM policy and guidance, modernize our IM workforce, and facilitate the development and application of state-of-the-art technologies. They are tangible, achievable, cost-effective, and will enhance the modernization of end-to-end

fisheries information management. They will help build the foundation for other longer-term actions to modernize our IM systems.

For each recommendation, the NOAA expert writing teams identified specific modernization importance and impact, outcomes and deliverables, roles and responsibilities, what actions and resources will be required, and an estimated timeline needed to complete the deliverables and milestones. Actions to address the recommendations and their completion are contingent upon available resources, ongoing events, and agency priorities and policies. Some recommendations are linked to one or more of the others, and may need to be carried out in tandem.

The recommended actions take into consideration past and ongoing modernization work executed by NMFS, other NOAA line offices, and NMFS IM partners. We note that a number of projects and actions are already underway that advance the objectives, deliverables, and outcomes outlined in the Workshop recommendations. These recommendations are not NMFS policy and do not reflect a commitment from NMFS.

Before responsible parties take action on addressing FIMM milestones and deliverables, there should be a thorough review of any duplicative or current information management modernization efforts within NOAA and across the Federal government. Some aspects of NMFS modernization efforts may be most successful with cross-line office collaboration, which should be determined for each milestone and deliverable within the recommendations.

Data and Information Governance

Recommendation 1: Plan and implement a NMFS Data Governance Framework.

Importance of Actions:

The recommended actions will focus on making strategic adjustments to the existing NMFS Enterprise Data Management (EDM) structure by developing a region-centric, nationally supported Data Governance (DG) Framework. This DG Framework will foster communication across all NMFS information management communities, clarify information management roles and responsibilities, and ensure transparent processes with greater accountability. Establishing a more agile and responsive data governance organizational

structure to manage growing data and information management needs, along with new and emerging information management requirements from both NOAA and the Federal government, including the new Federal Data Strategy and Evidence Act, will enable NMFS to better serve the public and our partners. The establishment of formal data governance was identified as a major recommendation from the [NMFS EDM Program Review](#) (2017) (Rec. ID 1, *Establish a Data Governance Model that is based on guiding, mentoring, empowering, and accountability of NMFS data stewards*).

The EDM mission supports NMFS customers to confidently find, access, understand, and use NMFS data. A formal data management framework is essential to providing sound data governance and accountability. It includes a data governance operating model along with policies, processes, and communication plans that ensure data and information assets are formally managed with clear roles and responsibilities.

Expected Outcomes and Impact:

Data Governance and Accountability actions in this recommendation will result in a more formal Data Governance Framework for NMFS EDM that maximizes effective communication across all NMFS information management communities and clarifies roles and responsibilities and ensures transparency and accountability.

Actions:

This action plan is modeled after the successful development and execution of national and regional NMFS Public Access to Research Results (PARR) and Electronic Technologies plans. High-level actions include:

1. Create a small Data Governance Implementation Team (DGIT) with regional and headquarters representation.
2. Review the proposed DG operating model (see EDM Program Review Report (2017)).
3. Research terms of reference and governance models from other NMFS and NOAA data coordination bodies.
4. Draft the National Data Governance Committee (DGC) terms of reference.
5. Create a National Data Governance Transition Plan that sets requirements for establishment or formalization of regional data governance.
6. Ensure NMFS leadership support and commitment to require NMFS regions to develop and implement regional DG implementation plans and to appoint Regional Data Coordinators to lead their respective Regional Data Governance Committees.
7. Plan and conduct a NMFS Data Governance Committee Workshop to identify regional and national information management needs and priorities. The National

Data Governance Committee will be the strategic, cross-regional data governance body.

8. Monitor the progress of regional DG implementation plans and report quarterly to NMFS leadership.

Deliverables and Milestones (est. 7 month effort)

1. Hold Data Governance Implementation Team Kick-off workshop.
2. Complete National Data Governance Transition Plan.
3. Submit draft financial management center (FMC) implementation plans.
4. Approve regional DG implementation plans from each FMC or region.
5. Hold National Data Governance Committee Workshop with the appointed Regional Data Coordinators.

Roles and Responsibilities:

1. The NMFS Information Architect will lead the EDM program and chair the National Data Governance Committee.
2. The Data Governance Implementation Team will develop the regional and FMC template and requirements for writing regional data governance plans.

Required Resources:

This recommendation will require travel funds and workshop expenses for 6-8 participants for three days to develop a strategy for developing a national implementation plan and template for regional implementation plans.

This recommendation supports Recommendation 2, developing a NMFS Information Management Plan for high-volume data, Recommendation 3, adopting and implementing a Data Maturity Matrix tool, Recommendation 5, updating the NMFS Data Management Planning Procedural Directive, Recommendation 9, implementing a Cloud Data Science Platform, and Recommendation 10, developing guidance for the adoption of industry best practices through software project and performance management tools.

Recommendation 2:

Develop a NMFS Information Management Plan for high-volume data systems.

Importance of Actions:

NOAA's operations and science products are rapidly becoming more reliant on big data observations and collections. Observing systems are capable of generating petabytes of environmental video, acoustic, genetics, and 'Omics data, and model output is growing exponentially. These systems – existing and in development - deliver data critical to building our scientific understanding and making management decisions, provided we can adequately acquire, log, store, process, and archive them.

NOAA and the Federal government recognize this new opportunity. The Big Data Program provides cloud storage and sharing capacity. NOAA's four Focus Area Strategies - Unmanned Systems, Artificial Intelligence, 'Omics, and Cloud - will expand NOAA's capability to use and apply emerging technologies and revolutionize the agency's observations, predictions, and understanding of the environment. Implementing these strategies will generate some of the largest datasets within the agency. Therefore, it is critical NMFS has a comprehensive plan for managing these data that takes into account the full data lifecycle.

The lack of a full and timely plan to manage these high-volume data streams and their derived products, and its implementation, will lead to a backlog for data providers, processors, and users, and an inability to use and share our data assets to conduct research and inform resource management and business decisions. Without proper planning, not only will these vital data become unusable, but extensive resources will be required in their long-term management, negatively affecting the agency's ability to effectively conduct our current information and resource management responsibilities.

Expected Outcomes and Impact:

The ultimate outcome of these efforts will be policy and guidance for data providers, processors, users, and stewards to locate, transport, process, and archive high-volume data sets and their metadata consistent with NOAA, DOC, and Federal requirements. These actions will help NMFS build and manage end-to-end systems to acquire and store video, acoustic, genomics, and other high-volume data. They will encourage the development of machine-learning capabilities to automatically package, transport, and process these data, create metadata, and extract specific data and information for further analysis and decision making. These actions will ensure adequate data storage services using cloud and on-premise servers and high-speed networks using public-private partnerships. These high-volume information management systems and policies will be consistent with and responsive to NOAA Focus Areas and IM legislation and orders, and use systems and tools already in place where possible.

Actions:

1. Create a high-level national NMFS High-Volume Data (HVD) Team to evaluate the current and future NMFS high-volume data producers and management requirements.
2. Reach out to managers of high-volume data systems in NMFS and other NOAA line offices, to learn from their data engineering decisions and look for areas of cooperation.
3. Identify the existing technical governance teams and create new ones for specific data types, sources, or priorities.
4. Identify drivers, scope out requirements (as needed), determine existing resources, capabilities, and parallel activities, and develop implementation plans.

Deliverables and Milestones (est. 10 month effort)

1. Form and convene the NMFS HVD Team.
2. Complete an assessment of the priority HVD systems and status of their technical teams.
3. Establish the remaining HVD technical teams.
4. Hold HVD technical team organizational meeting.
5. Publish a NMFS data management plan for high-volume data systems.

Roles and Responsibilities:

1. The Office of the Chief Information Officer (CIO) and the Office of Science and Technology (OST) will lead and coordinate these actions with input from across NMFS and in coordination with the NOAA OCIO and data management partners. This effort will use and require coordination among existing groups already working towards similar data and information management goals.
2. The HVD team will work in coordination with the NOAA OCIO and the NMFS OCIO.
3. The technical teams will be responsible for developing and implementing management plans for their specific data type or system.
4. NMFS representatives on the NOAA priorities will coordinate with NOAA strategy teams, the NOAA Observing Systems Council (NOSC), the CIO Council, and other bodies responsible for agency data collection and management.
5. The NMFS Information Architect will help coordinate and facilitate the above actions.
6. The NMFS Office of Policy will ensure policies are drafted according to NMFS guidelines, and work with OST and OCIO to ensure their compliance. In addition to Leadership Council review, these policies will be reviewed by the IT Policy Coordination Team (Recommendation 4).

7. Designees from the Regional Offices and Science Centers will act as the experts or reviewers on these teams.

Required Resources:

The required resources in this recommendation connect to Recommendation 10 on using industry best practices through software project and performance management tools.

This recommendation supports Recommendation 9 to implement a Cloud Data Science Platform, and is supported by Recommendation 1, planning and implementing a NMFS Data Governance Framework, and Recommendation 6, developing and adopting Program and Project Management Standards.

Recommendation 3:

Adopt and implement a NMFS Data Management Maturity Matrix tool.

Importance of Actions:

NMFS information management modernization efforts require the continuous tracking and periodic assessment of information management maturity and capabilities across our regions. Establishment of a DMMM was identified as a major recommendation arising out of the [NMFS EDM Program Review](#) (2017) (Rec. ID 2, *Develop data management maturity assessment tools that can be used to evaluate the current state of NMFS data management capabilities and can be used to set priorities and track improvements*).

There is currently no standardized method to evaluate the state of maturity of NMFS information management environments at either the FMC or national level. The lack of a standardized approach to this type of assessment inhibits efforts to evaluate priorities for modernization resources and to measure progress as modernization projects are implemented.

Expected Outcomes and Impact:

The evaluation of the results from a Data Management Maturity Matrix (DMMM) will help identify and prioritize continuous improvement efforts and information management modernization projects, inform NMFS leadership of the state of the current information management capabilities, and communicate and manage critical risks and plan proactively for needed resources. The implementation of a NMFS data management maturity assessment tool will enable NMFS to have a consistent format for reporting progress and

for communicating resource needs. Ensuring that the NMFS DMMM is consistent with the Federal DMMM will facilitate reporting up through NOAA and the Department of Commerce. The DMMM is also a mechanism to track the progress of the NMFS information management modernization efforts.

Actions:

1. Complete the draft of the Data Management Maturity Matrix tool.
2. Communicate the matrix to FMC leadership to socialize and get feedback, and commitment for initial and periodic evaluation at the FMC level.
3. Respond to feedback from the FMCs and finalize the matrix package (i.e., matrix tool, documentation, request letter).
4. Set a date for submission of matrix scores to the NMFS Information Architect.
5. The NMFS Information Architect will synthesize results and report them to the Fisheries Information Management Modernization (FIMM) team.
6. Report the results to NMFS leadership and the NOAA Chief Data Officer.
7. Schedule the next assessment.

Deliverables and Milestones (est. 4 month effort)

1. Finalize and approve the Data Management Maturity Matrix.
2. Receive the benchmark data management maturity scores determined by each NMFS FMC.
3. Send the synthesized report to NMFS leadership and NOAA Chief Data Officer on the current state of NMFS information management maturity.

Roles and Responsibilities:

1. The NMFS Information Architect will convene and lead a small team to review and revise the Federal DMMM for adoption and use at NMFS.
2. NMFS FMC leadership will review the DMMM and provide feedback to the Information Architect, and promote its adoption within their data programs when approved.
3. Technology and information management subject matter experts will provide their knowledge and expertise on the development of the DMMM.
4. Program managers of connecting systems will execute the initial and future data management maturity assessments and report their scores and feedback to their leadership.

Required Resources:

This recommendation will require the attention and commitment of NMFS leadership.

This recommendation supports Recommendation 2, developing a NMFS Information Management Plan for high-volume data, Recommendation 6, developing and adopting Program and Project Management Standards, and Recommendation 9, implementing a Cloud Data Science Platform. It is supported by Recommendation 1, planning and implementing a NMFS Data Governance Framework.

Policies and Procedures

Recommendation 4: Establish a coordinated process to develop and review the legal, technical, policy, and governance aspects of NMFS information management policies.

Importance of Actions:

Those tasked with information management and data governance need established, clear, and consistent rules to inform and guide their handling of agency data and implement the broad range of information management policies, procedures, and guidelines that are the cornerstone of data governance. New and emerging requirements coming out of NOAA, the White House, and Congress, in addition to emerging technologies for capturing and managing data, require NMFS' programs to be more efficient and agile in developing and adopting new or revised data and information management policies and procedural directives.

Unclear and ill-defined roles and responsibilities in developing, adopting, and communicating information management policies results in inefficient and inconsistent implementation within and across government agencies. A lack of clear and documented information management policies combined with weak communication can create an atmosphere of frustration and distrust within our agency where expectations are not made clear, and subsequently are not met. Additionally, inconsistencies in legal interpretations that remain unresolved at the national level can increase legal risk, and inconsistencies in implementing solutions can result in duplicative effort.

Expected Outcomes and Impact:

Establishing a framework that ensures partnerships and communication between the NMFS Enterprise Data Management Program, the NMFS Data Governance Committee (created through Recommendation 1), the Office of Policy, and the Office of General Counsel will result in more agile, coordinated, effective, and efficient information policy creation,

review, and implementation. In addition, it will create a community of practice where we improve the process of creating governing documents, foster trust and increase cooperation, and will serve as a shared resource. Technical and subject matter experts can then apply these guidelines to develop, review, and adopt information management policies, procedures, and guidelines that align with governing documents. The resulting processes will result in a nationally consistent approach to data governance and a more coordinated response to public requests, unified messaging, and processes for constituents (i.e., public fisheries partners requesting data access, paperwork reduction).

Actions:

1. Identify a cross line-office team that will develop the framework.
2. Define the NMFS data governance document repositories.
3. Identify data management policy gaps.
4. Research similar established policy coordination teams in NMFS and NOAA, to learn from their results and look for areas of cooperation.
5. Draft and establish policies and guidance to ensure data will be managed under clear and consistent rules.
6. Develop the official framework, and standard operating procedures and standardized best practices for developing and publishing NMFS information management governing documents.
7. Develop an internal communication plan and the expectations for it.
8. Publish the new process.
9. Create the IM Policy Coordination Team (IMPCT) and its terms of reference.

Deliverables and Milestones (est. 9 month effort)

1. Create the Information Management Policy Coordination Team (IMPCT) with the terms of reference.
2. Take inventory of existing governance documents to inform the development of the framework.
3. Approve the framework for drafting and clearing governance documents, and understand any existing processes.
4. Approve internal communication plan.
5. Roll out the framework and communication plan to NMFS programs.
6. Produce a prioritized list of governance documents for review and revision, and assignment to appropriate reviewers.
7. Develop and approve a process for facilitating FMC input into forms, policies, processes, and other tools to address national Magnuson-

Stevens Fishery Conservation and Management Act (MSA)
confidentiality issues.

Roles and Responsibilities:

The following will participate in a small group to develop the framework:

1. The NMFS Information Architect.
2. The Data Governance Committee.
3. Additional Members Based on Deliverable:
 - a. A representative from the General Counsel.
 - b. A representative from the Policy Office.

Required Resources:

This recommendation will have no direct costs. It will require the support of the DGC and office representatives, and the attention and commitment and leadership.

This recommendation supports Recommendation 1, planning and implementing a NMFS Data Governance Framework and Recommendation 6, developing and adopting Program and Project Management Standards.

Recommendation 5:

Update the NMFS Data Management Planning Procedural Directive to include regular data architecture revisions.

Importance of Actions:

The [NMFS Data Management Planning Procedural Directive](#) (DMP-PD) (2015) describes documenting and tracking requirements throughout the data management lifecycle. NMFS currently conducts a variety of distributed and regionally focused data activities, and manages its data in disparate systems and processes. An updated DMP-PD will improve processes and formats for more consistent data management. It will provide a framework for all current and new data activities, and will inform the modernization of data management capabilities across NMFS. Identifying the data users and roles, locations, flows, availability, and target-use in the updated DMP-PD will improve the NMFS data enterprise architecture, governance, access, and sharing in a manner that directly supports our national and regional information activities. In addition, it will foster collaboration that conforms to agreed principles for data stewardship and quality.

Expected Outcomes and Impact:

Updating the NMFS DMP-PD will provide a formal process for tracking data flows, and informing the reciprocal and continuous update of NMFS data strategy and capabilities.

Actions:

1. Identify who is responsible for managing the DMP-PD.
2. Identify DMP implementation models from other NOAA line offices to look for lessons learned and potential areas of collaboration.
3. Have a small team review and revise the DMP-PD and produce an updated DMP template.
4. Produce guidance for completing data management plans with lessons learned from the previous implementation of the DMP-PD.

Deliverables and Milestones (est. 4 month effort)

1. Complete the final draft of DMP-PD.
2. Receive the review and approval by regional data governance councils.
3. Publish and send the final, updated DMP-PD to regions.

Roles and Responsibilities:

1. The NMFS Information Architect will draft the procedural directive update.
2. The FMCs and Leadership Council will review and give final approval through the Policy Office using the Policy Directive clearance process.

Required Resources:

While updating the Procedural Directive in itself may not require substantial resources, the promotion, training, and implementation will require coordination. A regular review of the validity of the data architecture is recommended.

This recommendation supports Recommendation 2, developing a NMFS Information Management Plan for high-volume data, Recommendation 6, developing and adopting Program and Project Management Standards, and Recommendation 9, implementing a Cloud Data Science Platform. It is supported by Recommendation 1, planning and implementing a NMFS Data Governance Framework.

Recommendation 6:

Develop and adopt Program and Project Management Standards and Guidelines for information and technology projects.

Importance of Actions:

Key benefits of establishing standards for information management projects include the tracking of project performance and appropriate allocation of resources to data programs and projects. Additionally, NMFS will be able to comprehensively gather requirements and understanding for all stakeholders prior to significant resource investment. Standardized project management (PM) will include stakeholder communications across NMFS. Partners will be provided with the opportunity to report and share in the success of improving systems. Establishing roles and responsibilities with project and program managers will also enhance coordination and accountability in the development of new technology. Through standards of project management, NMFS will ensure documentation exists for all IM projects, support tools, and applications, and includes key elements to facilitate sharing and re-use of products and collaboration with other systems.

A failure to adhere to sound PM principles can lead to uncertainty in the appropriation of limited financial and human resources, and increase risks to successfully achieving information management modernization. Additional risks include unknown dependencies, unacceptable schedule delays, and critical decisions based on incomplete or misleading information, all of which can lead to costly and low-value projects.

Expected Outcomes and Impact:

The adoption of PM standards and guidelines will establish minimum standards for project management practices, documentation for data, and full life-cycle application, software, and technology development practices. In addition, it will help ensure the delivery of cost effective, high-value information management projects through hands-on project management support, and foster a better understanding of the project management lifecycle with sufficient training. These benefits will improve the organization's data maturity level in the areas of Data Governance, Systems and Technology, and Data Management and better enable information portfolio management within NMFS regions and, when appropriate, across the NMFS enterprise. Adopting and implementing standards will result in more efficient and effective project management, and less cost and resources.

Adopting program management best practices will support two key strategies for improving NMFS management of data identified in the 2017 NMFS EDM Program Review, 1) the *EDM Program Management Improvement Strategy*, recognizing that "sound program

management practices are essential in facilitating a program's ability to effectively and efficiently identify, plan, track, execute, and report on program objectives,” and 2) the *Enterprise Data Management Tools Improvement Strategy* to “provide cost-effective, user adopted data management tools.”

Actions:

1. Present the concept to the NMFS Data Governance Committee (Recommendation 1) to gain consensus on moving forward by setting objectives and timelines.
2. Create a Project Management Standards and Guidelines Development Team (PMST).
3. Survey the current PM practices and knowledge base within NMFS offices.
4. Research PM guidelines currently applied by NMFS other NOAA line office programs to look for lessons learned and potential areas of collaboration.
5. Create draft recommendations for NMFS standards and guidelines for project management.
6. Conduct a review and approve the adoption of PM Standards and Guidelines by the NMFS DGC.
7. Draft recommendations for NMFS staffing and training needs that will ensure quality information project management initiatives and projects.
8. Review, edit, and adopt the PMST Staffing and Training Recommendations by the NMFS DGC.
9. Submit PMST Staffing and Training Recommendations to NMFS Leadership for their consideration.
10. Work with the Software Design and Development professional specialty group (Recommendation 8) to promote their possible efforts in updating FMC’s application and tools inventory.

Deliverables and Milestones (est. 6 month effort)

1. Charter the PM Standards and Guidelines Development Team.
2. Complete the PM Standards and Guidelines and present them to the NMFS Enterprise Data Governance Committee.
3. Adopt the PM Standards and Guidelines by the NMFS Enterprise Data Governance Committee.
4. Present the PM Staffing and Training Recommendations to the DGC.

Roles and Responsibilities:

1. The NMFS Information Architect will lead, monitor, and report to leadership on this effort. Working with the NMFS DGC, the Information Architect will identify and

recruit subject matter experts to form PM Standards and Guidelines Development Team.

2. The NMFS DGC will charter a small team of experts to survey current PM practices and draft a proposal for NMFS project management guidelines and best practices (PM Standards Team). The NMFS DGC will be responsible for final adoption and promotion of PM Standards and Guidelines and the PMST Staffing and Training Recommendations.
3. NMFS DGC members, in their role as regional data officers, will oversee the implementation of the Project Management Standards and Guidelines within their region.
4. The PMST will survey the current PM practices and develop a PM Standards and Guidelines document under the guidance of the NMFS Information Architect and DGC. They will survey the current PM practices and knowledge base within NMFS offices and draft recommendations for NMFS standards and guidelines for project management. The team will also draft recommendations for NMFS staffing and training needs that will ensure quality information project management initiatives and projects.
5. The NMFS OCIO will provide critical knowledge and expertise.
6. The emerging Software Design and Development Professional Specialty Group (PSG) (Recommendation 8) will serve as key subject matter experts.

Required Resources:

There is no significant cost for this recommendation. Personnel time will be needed for the PMST. We encourage remote collaboration and leveraging resources developed by partners for implementing new tools for portfolio and project management.

This recommendation supports Recommendation 7, modernizing the NMFS IM workforce, and Recommendation 10, developing guidance for the adoption of industry best practices through software project and performance management tools. It is supported by Recommendation 1, planning and implementing a NMFS Data Governance Framework.

Personnel and Human Resources

Recommendation 7:

Modernize and expand the NMFS Information Management Workforce.

Importance of Actions:

A modern and diverse Information Management workforce will yield many benefits to the NOAA Enterprise by increasing the capacity and capability of those involved on the information side of data management, a critical component for timely fisheries management decisions. The Government Accountability Office (GAO) has identified a strong IT workforce as a key characteristic of effective Federal integrated program teams, and made several recommendations specific to the Department of Commerce to address its shortfalls in its IT workforce (GAO 2016). The GAO recommends Federal agencies fully implement key workforce planning activities to improve information management and efficiently use IT-related government funds ([Report of IT Workforce Planning](#) 2019). The GAO recommendations must be considered in agency IM workforce planning.

The current state of the NMFS IM workforce can be improved by increasing its diversity and inclusion of underrepresented groups, and through the organization and planning the use of NMFS personnel skills, needs, and capacity. IM specialists and scientists are performing multiple roles to assist with IM and the scientific data analysis essential for effective management of the nation's fisheries. Data management is difficult, time-consuming, and subject to delay and error when personnel are unavailable or not trained appropriately and are tasked to do jobs outside of their expertise. In addition, technology changes rapidly, making it difficult for IM specialists to update the essential knowledge and skills to perform high-level work and take advantage of new technologies. This results in poorly managed and undocumented data that is often not openly available or of the necessary scientific quality as mandated.

NMFS proposes moving forward with modernizing the IM workforce by:

1. Assessing the current IM capability and capacity.
2. Strengthening the current IM capability and capacity.
3. Expanding the IM workforce and related capability and capacity.

It is important to assess the current capabilities and capacities of the NMFS IM workforce to identify what NMFS has and what it may need. Once an assessment is conducted, NMFS can identify the gaps in knowledge and skill that will help efficiently expand and strengthen our workforce. Strengthening the IM workforce skill set will aid in developing a culture that acknowledges the importance of information management and allows staff to develop skills that meet the future needs of the NOAA mission. It is important to develop NOAA's next generation of data scientists at the same time we are developing our current staff. Therefore, expanding the IM workforce will allow the agency to benefit from the next generation of data scientists, meet new challenges, and increase the use of new technologies.

There is a large return on investment associated with a modernized IM workforce. Improved skills and knowledge will reduce the time to complete existing and future work activities, rotational or detail opportunities will unlock unused potential in NMFS employees, and the retention of highly capable employees through skills development reduces the overall cost of operations (e.g., cost to hire new staff is more than the cost of training and retraining). In addition, there will be cost savings related to cybersecurity because a modernized workforce fosters experts in development, network management, and other critical fields.

The GAO developed a guide to assist agencies and bureaus with developing their IT workforce plans (DOC IT Workforce Planning Guide 2017) in addition to competency requirements for IT program managers. The competencies were included in the Commerce Acquisition Manual that identifies education, experience, and training requirements for program and project managers who are responsible for the acquisition of IT investments (Commerce Acquisition Manual 1301.671).

7a. Assess NMFS IM workforce capabilities and capacity

Throughout the FIMM Workshop, participants identified challenges in collecting and managing scientific data. It is recommended that the NOAA Office of Human Capital Services (OHCS) facilitate the creation of an inventory of skill sets, current positions, and professional development and training opportunities.

Actions:

1. Identify current skills through a skills inventory.
2. Identify current IM-related positions.
3. Identify existing professional development and training opportunities.

Deliverables and Milestones (est. 12 month effort)

1. Take inventory of skills.
 - a. Communicate the initiative to explain and socialize its importance.
 - b. Conduct a skills survey.
 - c. Conduct face-to-face interviews.
 - d. Analyze the data and report on the findings.
 - e. Develop a potential list of needed job and career tracks (supports Recommendation 7c. Expand Workforce).
 - f. Communicate the results of surveys and interviews to explain the next steps.
2. Conduct an inventory of current IM-related positions.

3. Collect an inventory of currently used and available development, learning, and education opportunities (beyond the Commerce Learning Center) and identify what opportunities have proven successful.

Role and Responsibilities:

1. The OHCS will create an inventory of skill sets, current positions, and professional development and training opportunities.
2. The NOAA Workforce Management Office, Regional level, data managers will assist the OHCS with coordination of meetings and collection of data.
3. External partners in coordination with OHCS will lead workshops related to position explanations, skills development, and best practices.
4. Training managers will be responsible for developing and tracking training requirements and opportunities for their teams.

Required Resources:

Conducting the assessments to accompany this element of the recommendation will result in unlocked skills from existing full-time equivalents (FTEs) and identify gaps in current workforce staffing and capability. To conduct these surveys across all regions, NMFS will contract an external vendor to provide consistency and thorough investigation at the local levels while avoiding duplication of work.

7b. Strengthen NMFS IM workforce skill set

Strengthening the NMFS IM workforce skill set will require partnership with the Office of Training and Knowledge Management (OTKM) to develop additional training programs specific to skill sets required for all positions that process, manage, or collect NMFS data. These recommendations will enable clear communication among hiring managers regarding the necessary skills required for employees and contractors filling positions in data management (e.g., scientists, business analysts, developers). It will also direct the development of training programs to train and re-train current employees. Appropriate training and associated skill set growth will encourage employee retention and increase productivity and job satisfaction.

Actions:

1. Develop performance plan requirements.
2. Share data management, programming, and software development questions and ideas.

3. Establish professional development and training opportunities, and make these available to the workforce.
4. Evaluate training opportunities provided by NOAA, DOC, and other Federal programs.

Deliverables and Milestones (est. 12-24 month effort)

1. Develop new requirements in Performance Plans (i.e., mandatory minimum requirements of training and learning opportunities).
2. Create an internal forum, or utilize an existing public forum for exchanging ideas and troubleshooting questions related to data management, programming, and software development.
3. Develop new ways to communicate information (i.e., guest expert speakers, hackathon).
4. Examine attrition rates of key positions and skills.
5. Establish professional development and training opportunities.
 - a. Update training pages on Intranet to include opportunities.
 - b. Develop and train supervisors regarding inclusion in performance planning.
 - c. Develop metrics to track the progress of skills and capacity.

Roles and Responsibilities:

The actions of this recommendation could be supported by the EDM program, the DGC, or the forthcoming Software Design and Development Professional Specialty Group (Recommendation 8), pending its creation. The DGC will work with the OTKM to coordinate the actions of this recommendation. IM employees, with their supervisors, will identify and take appropriate training. IM managers will make employees aware of training opportunities, and support, fund, and track training.

Required Resources:

There will be a cost associated with tuition and training, travel for training, and conducting IM activities while employees are in training.

7c. Expand NMFS IM workforce

This element of the recommendation will expand the NMFS IM workforce by developing relationships with college and university career centers, and targeting programs that include data science, computer science, and other disciplines as appropriate. It will also utilize the NMFS Communications staff to share NOAA's mission to audiences (including underrepresented groups) that may not be considering employment by our Agency and

work toward a more diverse and inclusive workforce. NOAA leadership should support the creation of new job tracks or job series (e.g., business analyst, project manager) as appropriate. In addition, NMFS will develop a process to track needed training for incoming personnel to provide clarity on expectations and consistency around learning goals for new staff.

Actions:

1. Conduct college outreach and recruiting programs.
2. Add job track and series as appropriate.
3. Develop communications and outreach products on the importance of data science and opportunities to use them at NOAA.
4. Track the necessary training for incoming personnel.

Deliverables and Milestones (ongoing effort)

1. Update job series.
2. Recruiting and outreach, particularly to underrepresented groups.
3. Develop a method to track needed training for incoming personnel.

Roles and Responsibilities:

1. The Chief Learning Officer will conduct college outreach and recruiting programs.
2. NMFS OST will identify potential new positions and encourage NOAA and DOC leadership to submit a request to the Office of Management and Budget (OMB) for a new job track and series.
3. NOAA Communications will develop communications and outreach products on the importance of data science and opportunities to use them at NOAA.

Required Resources:

Required resources include staff time, adding job duties for other existing staff, and the cost for additional FTEs.

The success of this recommendation depends on Recommendation 1, planning and implementing a NMFS Data Governance Framework, Recommendation 2, developing a NMFS Information Management Plan for high-volume data, Recommendation 6, developing and adopting Program and Project Management Standards, and Recommendation 9, implementing a Cloud Data Science Platform. A modernized IM workforce strongly supports all recommendations.

Recommendation 8:

Establish a NMFS Software Design and Development Professional Specialty Group.

Importance of Actions:

Application developers are at the forefront of information modernization efforts and the streamlining of fishery information systems. However, those who develop NMFS applications may be isolated geographically and administratively, and have limited opportunity to engage with their peers and partners across regions. As a result, similar problems are solved independently, wasting time, effort, and money.

This Professional Specialty Group (PSG) will give innovators working with fisheries information a forum where they can share their expertise and project successes and setbacks for developing, implementing, and socializing software. This will provide benefits to the entire agency by increasing productivity and decreasing redundant efforts and leveraging existing work and solutions. In addition, this PSG will promote creativity among developers, increase software innovation and motivation by the use and sharing of new tools, and build a stronger community by spreading knowledge and building connections to people and appropriate resources.

Expected Outcomes and Impact:

The Fisheries Information System Program Management Team (FIS PMT) will facilitate the formation of a Software Design and Development Professional Specialty Group (SDD PSG). The purpose of the SDD PSG is to build a community of like-minded individuals across NMFS and its partners for the purposes of sharing information, best practices, and lessons learned. The SDD PSG will also convene experts from multiple disciplines to explore opportunities for innovation, to identify and overcome common application and software development challenges, and to ensure that the systems and tools being designed or implemented work synergistically across NMFS and its partners.

Actions:

1. Determine if the SDD PSG will stand alone or operate under the existing FIS structure.
2. Receive approval of the SDD PSG formation.
3. Commit to appropriate financial and logistical support of SDD PSG.

Deliverables and Milestones (est. 3 month effort)

1. Draft terms of reference for SDD PSG.
2. Determine founding membership.

3. Hold the first monthly teleconference.
4. Hold the first annual SDD PSG meeting.

Roles and Responsibilities:

1. The FIS PMT will oversee the formation of the PSG and provide logistical support as well as guidance on priorities. The FIS PMT will ensure the PSG includes a diverse group of experts from across NMFS and its partners.
2. PSG membership will consist of appropriate application developers from NMFS headquarters, regional offices, science centers, FINs, and other state partners. These developers may include fisheries biologists, statisticians, database developers, and information technology specialists. The key factor will be an interest and experience in developing programs and applications that enhance NMFS information processes.
3. Once established, PSG members will be responsible for attending and contributing to all PSG meetings and assisting with special activities as determined by the PSG and PMT.

Required Resources:

This action will require minimal cost. If this group is established under FIS, the PSG will have a minimum of one face-to-face meeting per year that is funded by the FIS program. Staff time will be required, including monthly teleconference PSG meetings, an annual SDD PSG meeting, and occasional special requirements. By sharing application development resources and products through the SDD PSG, NMFS will realize significant cost savings as different organizational units work towards similar goals.

This recommendation supports Recommendation 6, developing and adopting Program and Project Management Standards, and Recommendation 7, modernizing the NMFS IM workforce.

Technology

Recommendation 9:

Implement a NMFS-wide cloud-based data science, management, and publishing platform (the Cloud Data Science Platform).

Importance of Actions:

Currently NMFS manages many datasets at the regional level, with inconsistent and ineffective storage and processing methods. The NMFS Cloud Data Science Platform (CDSP) will modernize data storage, management, and processing, data science, and data extraction to use our data holdings efficiently across NMFS. The CDSP will break down organizational barriers and increase efficiency, increase NMFS's capacity for combining and working with large and complex data sets, enable new capabilities such as machine learning and other data science tools, and provide data visualization and publishing of tabular, spatial, and other multi-dimensional data to all audiences across NMFS.

Expected Outcomes and Impact:

The NMFS CDSP is an implementation of the high-volume data enterprise data management plan (Recommendation 2). It will have multi-terabyte storage and compute capacity for working with and combining large and complex data sets, including file storage, big data stores, and relational databases. It will have the capabilities for data and processing with a broad national scope, and also the flexibility for regional or individual needs and experimentation. This platform will have data management and science tools for processing, analyzing, and generating new information from these data, such as R, Python and Jupyter Notebooks, Machine Learning and ArcGIS Enterprise and Portal. Collaborators will have the ability to share code. In addition, the CDSP will have the capacity to publish tabular, spatial, and multi-dimensional data and metadata within the agency, external partners, as well as sharing them with the public. Examples of these tools include NMFS SWFSC Environmental Research Division's Data Access Program (ERDDAP), ArcGIS Enterprise and Portal, and RStudio Connect.

Actions:

1. Form a Cloud Data Science Team of project management, data science, data management, technology, and security staff from across NMFS who will develop the requirements for the CDSP.
2. The Cloud Data Science Team will research existing tools and initiatives across NMFS and NOAA and in the commercial sector, and identify potential for collaboration.
3. The Cloud Data Science Team will produce a pilot project design document that details essential parts of the CDSP, such as networking, storage, compute capacity, user identity and access, security mechanisms, and essential data science software tools. The pilot project will focus on enriching Automatic Identification System (AIS) position data from Alaska (where there is already an AIS data agreement) with oceanographic and environmental data, using machine learning to detect fishing

behavior, and creating gridded products that summarize fishing distribution and intensity over time.

4. The Cloud Data Science Team will explore the feasibility of using AIS data from the Global Fishing Watch project stored in the Google Cloud Platform, as well as passive vessel positioning from Hawkeye360 satellites.
5. Implement the pilot project infrastructure, building out the cloud storage, networking, and compute components, and install data science, management, and publishing tools.
6. Demonstrate through the pilot CDSP how vessel position data from AIS can be enriched with oceanographic and environmental data from the SWFSC's ERDDAP server and fishery-independent survey data from other science centers, and then tagged with fishing activity via machine learning algorithms with the result published as gridded data sets.
7. Form a CDSP Steering Committee to evaluate requests for new components, data, and features in the Platform, submitted to the Committee through online forms and evaluated through an online ranking system.
8. Collaborate with other NMFS data programs to add additional data sets such as commercial catch data, vessel monitoring systems, and observer data.

Deliverables and Milestones (est. 12-18 month effort)

1. Form the Cloud Data Science Team and hold a kick-off meeting.
2. Complete the NMFS CDSP pilot project design.
3. Complete the overall CDSP requirements and design.
4. Receive security approval for moving forward with the pilot project.
5. Evaluate requests for new features.
6. Build out the CDSP to support the pilot project, including file, database, and data stores, data science virtual machines, and data publishing and visualization tools.
7. Complete the pilot project, delivering AIS positions enriched with environmental data and fishing behavior tags, and summarized fishing distribution and density grids.
8. Publish lessons-learned document from the pilot project with steps moving forward.

Roles and Responsibilities:

1. The Cloud Data Science Team will provide technical and subject matter expertise, produce requirements and design documents, secure data agreements, implement a pilot, and draft the findings with next steps. The OST and OCIO will facilitate its formation.

2. The CDSP Steering Committee will evaluate and approve requests for new shared components and data sets to be added to the Data Platform.
3. The project manager will work with Cloud Data Science Team to keep the team on task, informed, on budget, and on time.
4. The NMFS ACIO will provide guidance on cloud provisioning, network design, and security.
5. The NMFS Information Architect will ensure that plans for the CDSP are congruent with NMFS data management strategy and goals.
6. The NMFS Alaska Regional Office will provide Python code for AIS ingest, spatial enabling, and other pre-processing.
7. NMFS AFSC will provide R code for combining AIS and environmental data.

Required Resources:

The resources required for this recommendation will cover costs for establishing and maintaining the CDSP, and the staff time required for the CDSP’s implementation and application.

1. Services and fees.
2. Additional satellite passive vessel coverage from Hawkeye360.
3. Project manager: staff member from participating FMCs and HQ.
4. Cloud Data Science Team: subject matter experts in: cloud computing, spatial data management and analysis, environmental data (e.g ERDDAP, data science, ecosystem environmental analysis).

The success of this recommendation depends on Recommendation 2 to develop a NMFS Information Management Plan for high-volume data and is supported by Recommendation 1, planning and implementing a NMFS Data Governance Framework and Recommendation 4, which will produce policies and guidance to inform CDSP operations.

Recommendation 10:

Develop NMFS guidance for the adoption and use of software project and performance management tools.

Importance of Actions:

A variety of commercial tools available to aid in the software development process — such as Github, Jira, and Asana — are cloud-based and available to small software and

application development teams. Currently, however, no NMFS-wide guidance exists on the adoption and use of these best-in-class tools.

There are many benefits to using these dedicated tools (e.g., easier collaboration with partners and users, better development team communications, sharing and access and version-control of code, standardizing process, integrating new team members, enabling remote work). Developing and disseminating common agency-wide guidance will reduce the need for NMFS software developers to create ad-hoc internal policies, provide more consistency in the adoption and use of these tools, and encourage their use. The risk of not doing this is more inefficiency and inconsistency in the use of developer tools, requiring more time by developers, duplication of effort in developing multiple sets of guidance across the agency, and reduced ability to collaborate in software development and project management.

Expected Outcomes and Impact:

Based on a recommendation made at the FIMM Workshop, this action will provide NMFS, and partners (such as Fishery Information Networks and other state partners) clear guidance on both the adoption and use of commercial project management and productivity tools for software development and application. This guidance will help development teams leverage best-in-class tools to aid in the software development process while still complying with established NMFS policy.

Actions:

1. Establish a cross-regional team to develop guidance.
2. Identify what developer tools are currently used or requested within the NMFS community.
3. Research existing examples of policy or guidance at NMFS FMCs, other NOAA line offices, or other Federal agencies.
4. Use research as a foundation to draft common guidance.
5. Conduct a broad NMFS-wide review.
6. Revise and produce final guidance for approval and adoption.

Deliverables and Milestones (est. 6 month effort)

1. Hold an initial meeting to scope out actions and identify teams and leads.
2. Reach out to existing regional and national users for their needs and determine what has already been created and established.
3. Publish final NMFS guidance for the adoption and use of Github commercial software project management and production tools.

4. Publish plan for future guidance on use of program and project management tools.

Roles and Responsibilities:

The OST Science Information Division Director and the OCIO Technology Delivery and Operations Division Director will coordinate this effort.

Required Resources:

Time commitment from subject experts will be needed to research existing policy and guidance, and to draft a common guidance document. There are no recurring costs.

The success of this recommendation depends on and is supported by Recommendation 6, developing and adopting Program and Project Management Standards. It is also supported by Recommendation 1, planning and implementing a NMFS Data Governance Framework.

4. Conclusion

The recommendations from the FIMM Workshop, curated and reviewed by a diverse set of IM experts, provide specific and tangible steps to modernize the way data is collected, processed, stored, and archived. They provide direction for moving to an information management culture that values and effectively leverages data as a strategic asset. These recommendations address Federal and NOAA drivers, strategies, policies, and practices related to data and how it is managed, and will set the foundation to respond to incoming Big Data and emerging technologies.

The actions identified in this Technical Memorandum will provide sound data governance and accountability, coordinate the development and adoption of IM policy and guidance, modernize our IM workforce, and facilitate the development and application of state-of-the-art technologies. When the recommendations are implemented, followed consistently, and supported by leadership, the fisheries IM enterprise will experience efficiencies in data management and use, cost reductions, more efficient communication and information processing, more timely and accurate scientific analysis and products, and better decision support. Workshop organizers and participants acknowledge these are the first steps in a longer, iterative process, but they are essential to modernize the Nation's fisheries information management.

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Appendix A. Workshop Scope and Agenda

Scope

The scope of the FIMM Workshop was to review and evaluate practical and incremental steps to holistically modernize the data and information ecosystem of the National Marine Fisheries Service, its state partners, the Fishery Information Networks, and other partners. Information modernization efforts will include integrating and streamlining NMFS fishery-dependent and fishery-independent data and information, and the information flow processes of all NMFS fishery, environmental, and socioeconomic data. Workshop participants reviewed the existing fisheries information management processes and identified how modernizing the components of these processes would benefit our data/information producers, processors, and consumers.

Agenda

Tuesday, September 17th

QUESTION OF THE DAY

What are the fisheries information management modernization needs and priorities of our data producers and consumers?

Time	Speaker(s)	Agenda Topic	Action / Outcome	Notes
8:00-8:30am	COFFEE / TEA			
8:30-8:40am	Frank Schwing Welcome			Day 1 is open to the public and stakeholders
8:40-9:10am	Jon Hare	Overview of Fisheries Data Flow Systems and their Connectivity	Provide background information on NMFS' role in US fisheries information management; data flow with state partners and across regions.	Leadership, business users, partners
9:10-9:25am	Patrick Lynch	Science Information Needs	Modernization needs for improved timeliness and accuracy of data products.	

9:25-9:40am	Jessica Stephen	Management Information Needs	Modernization needs to improve immediate decision making.	
9:40-10:00am	Mike Cahall	Importance, Challenges, and Successes of Partnerships	Partnership Case Study: <i>Challenges and successes of federal-state partnerships.</i>	
10:00- 10:30am	Panel Discussion: Fisheries Drivers and Partnerships			
		Alan Lowther Program Manager, FIS (Moderator) Patrick Lynch Division Chief, Assessment and Monitoring, NMFS OST Jessica Stephen Data Manager, SERO Mike Cahall Former Director, ACCSP Geoff White Director, ACCSP Bob Ryznar Program Manager, AKFIN		
10:30-10:45am	BREAK			
10:45-11:15am	Sarah Margolis, Alan Lowther, and Lisa Peterson	Data Call Results	Share results of the data call to workshop attendees; explain connections to focus questions for breakout groups.	
11:15-12:15pm	Kate Wing and Karen Sender	Affinity Diagramming Activity	Activity to identify producer and consumer modernization priorities.	
12:15-1:30pm	LUNCH			
1:30-1:40pm	Frank Schwing and Alan Lowther	Charges to Participants	Describe the charges to the workshop participants.	
1:40-4:00pm	Breakout Groups	Breakout Group 1: Technical/Logistical Aspects of Modernization Breakout Group 2: Policy/Governance Aspects of Modernization Breakout Group 3: Personnel/Cultural Aspects of Modernization	Breakout groups break on their own	
4:00-4:15pm	BREAK (Leads meet to summarize Day 1 morning breakout group discussions)			

4:15-4:45pm	Breakout Group Leads	Report Out	Leads will report breakout group discussions in a plenary session.
4:45-5:00pm	Frank Schwing Wrap Up		

Wednesday, September 18th

QUESTION OF THE DAY

How can we identify and prioritize fisheries information management modernization solutions to fit our producer and consumer needs?

Time	Speaker(s)	Agenda Topic	Action / Outcome	Notes
8:00-8:30am	COFFEE / TEA			
8:30-8:45am	Frank Schwing Day 1 Summary			Day 2 is open to the public and stakeholders
8:45-9:00am	Ed Kearns	NOAA Enterprise and Larger Federal Modernization Efforts	Discuss NOAA and Federal Cloud and Data Strategies.	NOAA-level requirements and lessons from line offices and partners
9:00-9:15am	Tyler Christensen	NOS Data Modernization	NOAA Line Office Case Study: <i>NOS Shared Challenges, and Success Story.</i>	
9:15-9:30am	Julie Simpson	Data Consolidation and Accessibility	Partnership Case Study: <i>ACCSP Shared Challenges, and Success Story.</i>	
9:30-9:45am	Jordan Watson	Data Streamlining, Successful Architecture, Collaboration and Workflow	NOAA Case Study: <i>NMFS Shared Challenges, and Success Story.</i>	
9:45- 10:30am	Panel Discussion: <i>Modernization Perspectives</i>			

	<p>Ed Kearns Chief Data Officer, NOAA (Moderator) Tyler Christensen Metadata Coordinator, Office of the ACIO, NOS Julie Simpson Deputy Director, ACCSP Jordan Watson Mathematical Statistician, AFSC Rost Parsons Deputy Director, Center for Coasts Oceans and Geophysics, NOAA Mashkoor Malik Physical Scientist, OAR</p>		
10:30-10:45am	BREAK		
10:45-11:00am	<p>Frank Schwing and Alan Lowther Plenary to review remaining comments from panel discussion and describe charges to Day 2 Breakout Groups.</p>		
11:00-12:15pm	Breakout Groups	<ol style="list-style-type: none"> 1. Designing for Core Needs 2. Automate and Simplify Data Access 3. Collaboration and Design 4. Policy/Data Governance and Automated Data Permissions 	Visions for success
12:15-1:45pm	LUNCH		
1:45-3:15pm	Breakout Groups	<ol style="list-style-type: none"> 1. Internal Capacity Building and Cross-Office Training/Learning 2. Efficient Dataflows and Closing Data Gaps 3. Data Stewardship 4. Better User Design and Experience for Data Collectors 	Visions for success
3:15-3:30pm	BREAK (Leads meet to summarize Day 2 afternoon breakout group discussions)		
3:30-4:15pm	Breakout Group Leads	Report Out and Discussion	Leads will report breakout group discussions in a plenary session.
4:15-4:45pm	Kate Wing and Karen Sender	Maturity Matrix Discussion	Discussion on maturity matrices and how to integrate a matrix into modernization solutions on Day 3.
4:45-5:00pm	<p>Frank Schwing Wrap Up</p>		

Thursday, September 19th

QUESTION OF THE DAY

What are the actions needed to address fisheries information management modernization?

Time	Plenary Sessions with Actions / Outcomes	Notes
8:00-8:30am	COFFEE / TEA	
8:30-9:30am	Frank Schwing and Alan Lowther Plenary to address how breakout group discussions fit together across roles, regions, data types, etc.	Day 3 morning session is open to the public and stakeholders
9:30-9:45am	BREAK	
9:45-12:00pm	Frank Schwing and Alan Lowther Plenary to wrap up workshop and discussions: short-term (12-24 mo.) and long-term (3-5 yr.) modernization solutions and metrics.	
12:00-1:00pm	LUNCH	
1:00-3:00pm	Action-Filled Plenary Breakout into short-term and long-term groups to design a roadmap with tangible steps for leadership to follow.	Closed - NMFS employees and affiliates only
3:00-3:15pm	BREAK	
3:15-4:30pm	Plenary to discuss Day 3 Breakout Groups.	Closed - NMFS employees and affiliates only

Appendix B. Data Call Results

Data Production

The graphs below show responses from the pre-Workshop data call of (1) those associations with fishery-dependent vs. fishery-independent data, (2) NOAA vs. Partners demographics, and (3) Producers vs. Processors vs. Consumers of fisheries information. The respondents were asked to rate aspects of modernization in the context of data production at their organization with the following scale: **(0= No opinion, 1= Poor 2= Fair 3= Good 4= Excellent)**. The figures below show the proportion of 'positive responses', those who chose 'good' or 'excellent'.

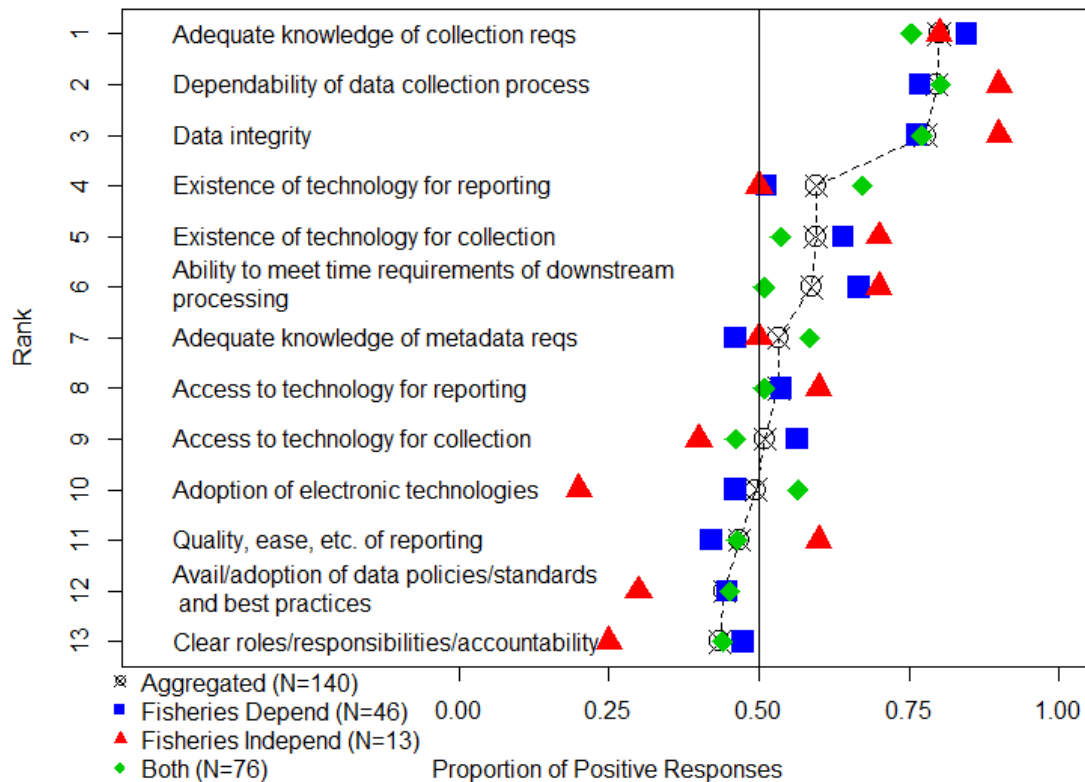


Figure B1. The proportions of positive responses regarding aspects of information management at respondent's organization in the context of data production. Responses are organized by the associations to fishery-dependent vs. fishery-independent data. This graph shows similar responses across respondents; however, fishery-independent respondents scored differently on certain aspects than their counterparts.

Information management at your home institution
Context of data production (collection of primary and/or raw data)

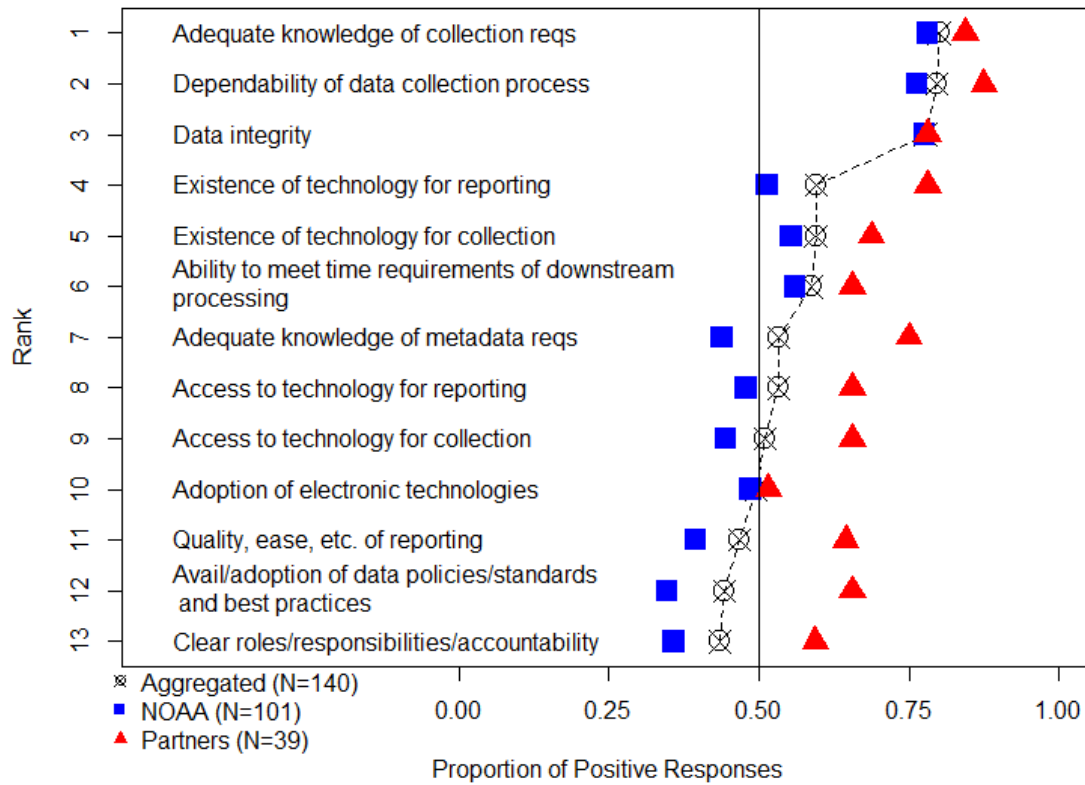


Figure B2. The proportions of positive responses regarding aspects of information management at respondent's organization in the context of data production. Responses are organized by NOAA vs. Partners. In general, responses from the partners of NMFS were higher than the responses of NOAA.

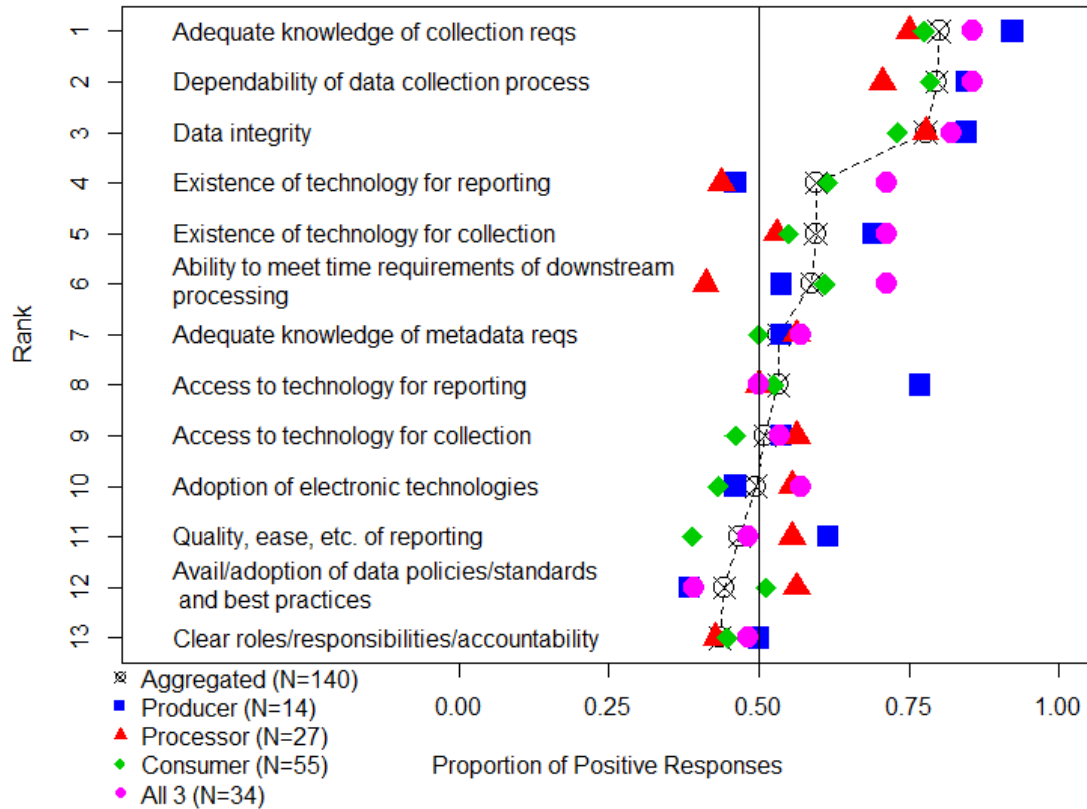


Figure B3. The proportions of positive responses regarding aspects of information management at respondent's organization in the context of data production. Responses are organized by Producer vs. Processor vs. Consumer. This graph shows similar responses across respondents; however, producers and processors have varying proportions of positive responses.

Data Processing

The graphs below show responses of (1) those associations with fishery-dependent vs. fishery-independent data, (2) NOAA vs. Partners demographics, and (3) Producers vs. Processors vs. Consumers of fisheries information. The respondents were asked to rate aspects of modernization in the context of data processing at their organization with the following scale: **(0= No opinion, 1= Poor 2= Fair 3= Good 4= Excellent)**. The figures below show the proportion of 'positive responses', those who chose 'good' or 'excellent'.

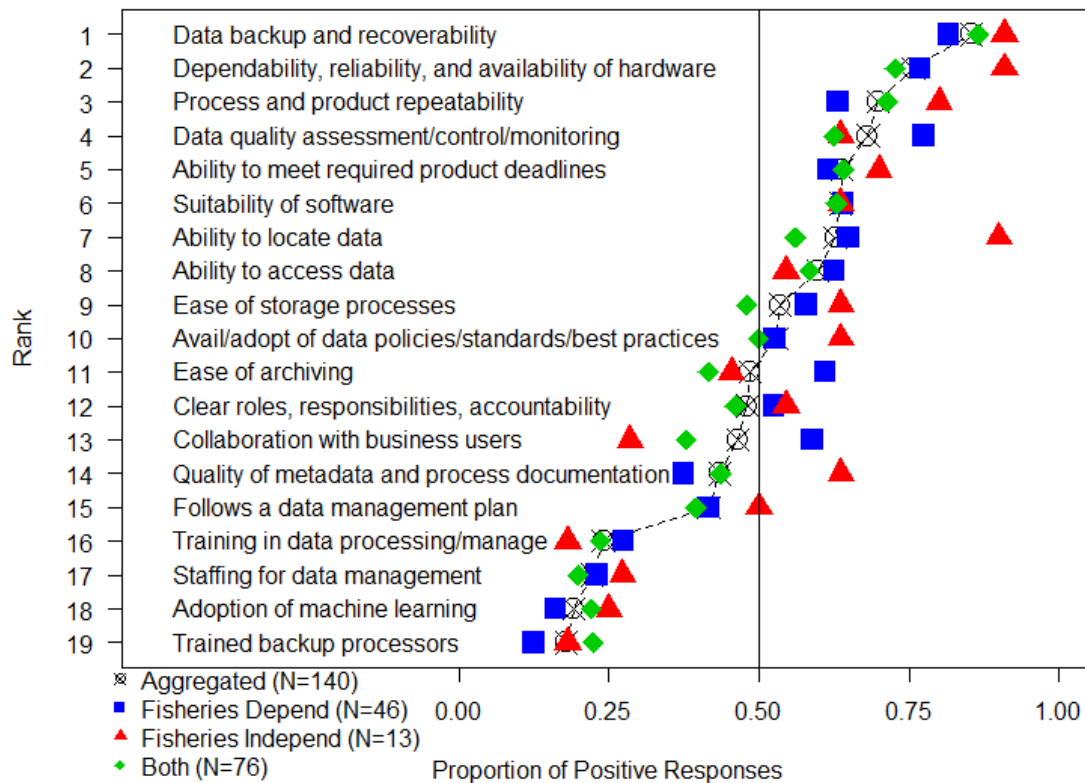


Figure B4. The proportions of aggregated positive responses regarding aspects of information management at respondent's organization in the context of data processing. Responses organized by the associations to fishery-dependent vs. fishery-independent data. This graph shows similar responses across respondents; however, fishery-independent respondents have more varied proportions of positive responses.

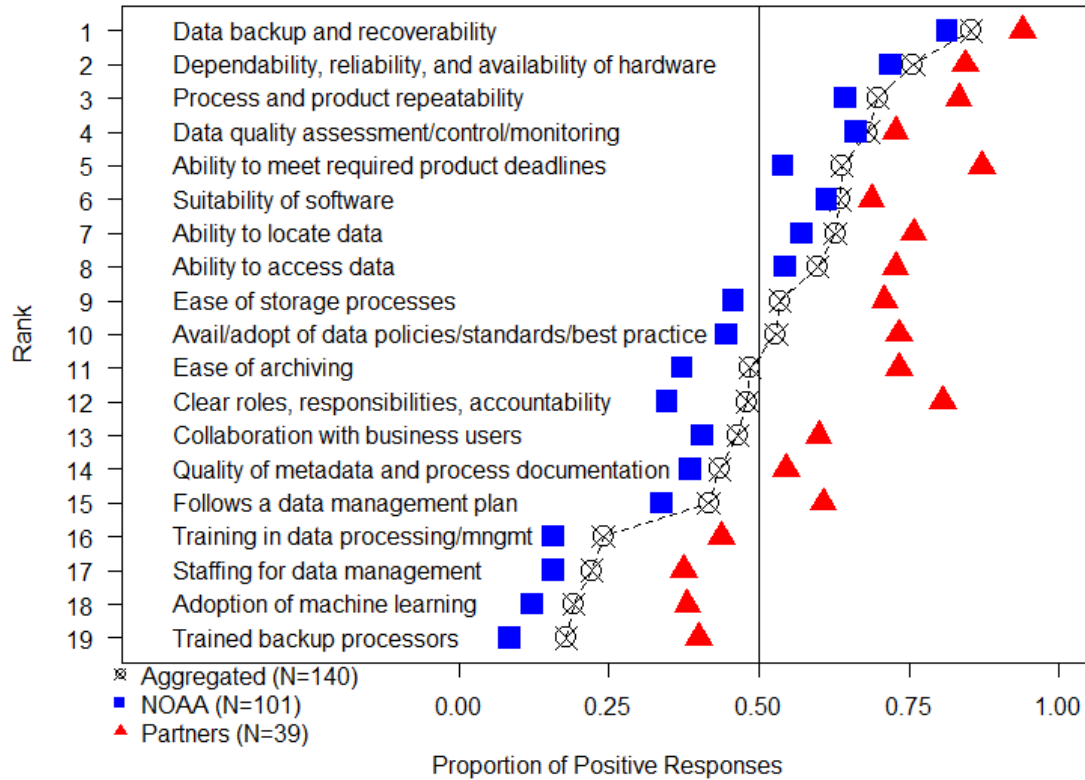


Figure B5. The proportions of aggregated positive responses regarding aspects of information management at respondent's organization in the context of data processing. Responses organized by NOAA vs. Partners. In general, responses from the partners of NMFS were higher than the responses of NOAA.

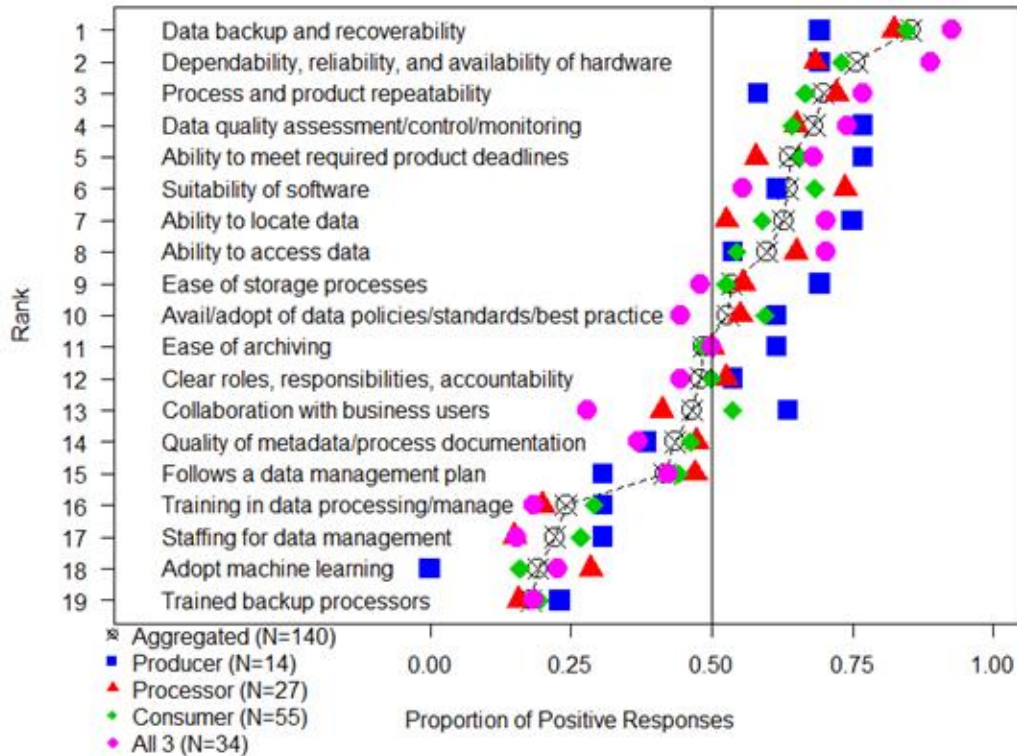


Figure B6. The proportions of aggregated positive responses regarding aspects of information management at respondent's organization in the context of data processing. Responses organized by Producer vs. Processor vs. Consumer. Responses varied to a small degree.

Data Consumption

The graphs below show (1) the aggregated data of all respondents, (2) associations to fishery-dependent vs. fishery-independent data, (3) NOAA vs. Partners, and (4) Producers vs. Processors vs. Consumers. The respondents were asked to rate aspects of modernization in the context of data consumption at their organization with the following scale: **(0= No opinion, 1= Poor 2= Fair 3= Good 4= Excellent)**. The figures below show the proportion of 'positive responses', those who chose 'good' or 'excellent'.

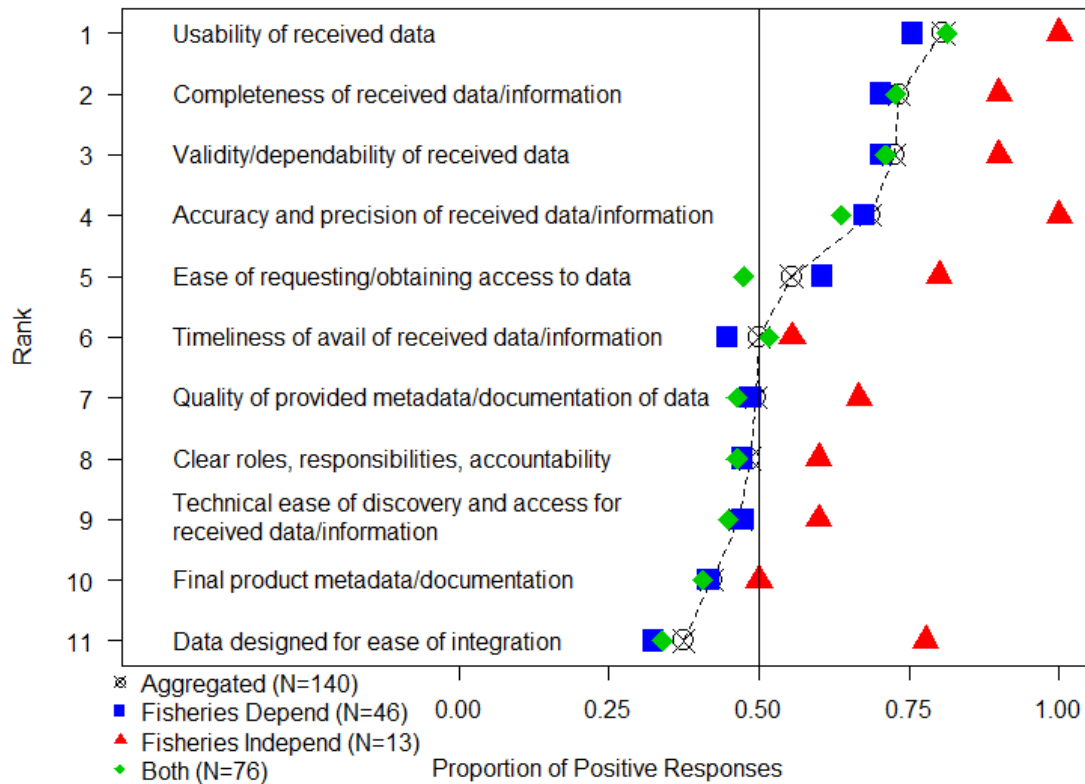


Figure B7. The proportions of aggregated positive responses regarding aspects of information management at respondent's organization in the context of data consumption. Responses organized by the associations to fishery-dependent vs. fishery-independent data. This graph shows similar responses across respondents; however, fishery-independent respondents have consistently higher proportions of positive responses.

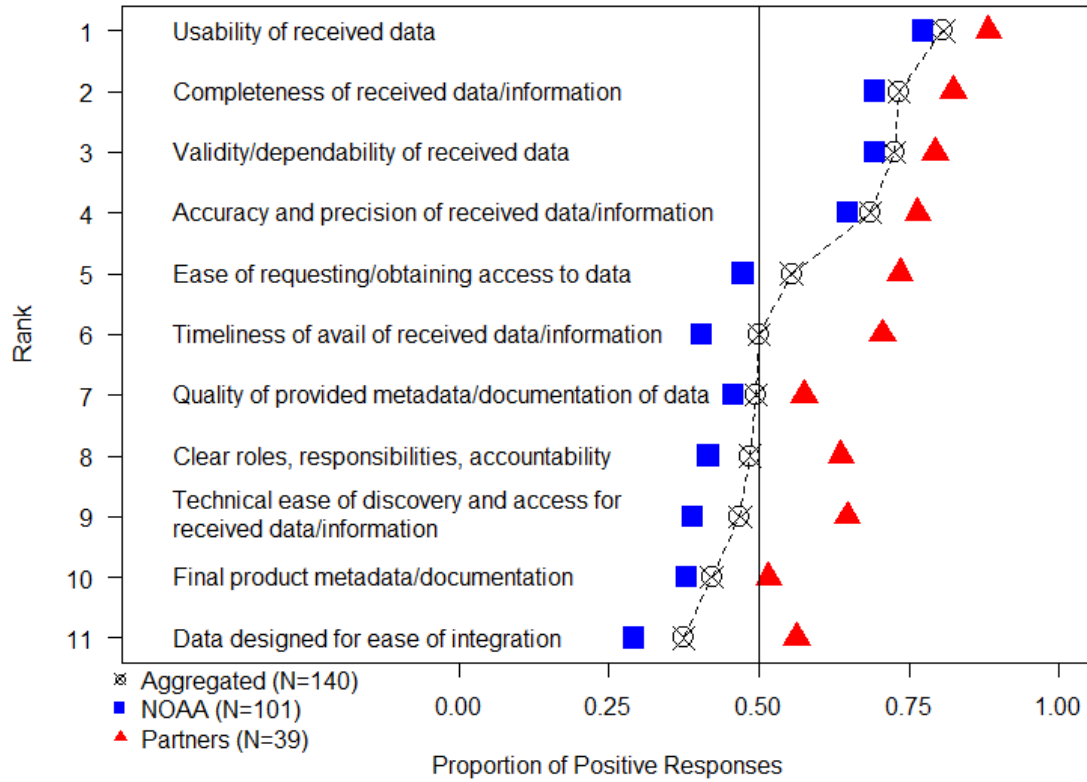


Figure B8. The proportions of aggregated positive responses regarding aspects of information management at respondent's organization in the context of data consumption. Responses are organized by the associations to NOAA vs. Partners. In general, responses from the partners of NMFS were higher than the responses of NOAA.

Information management at your home institution Context of data consumption

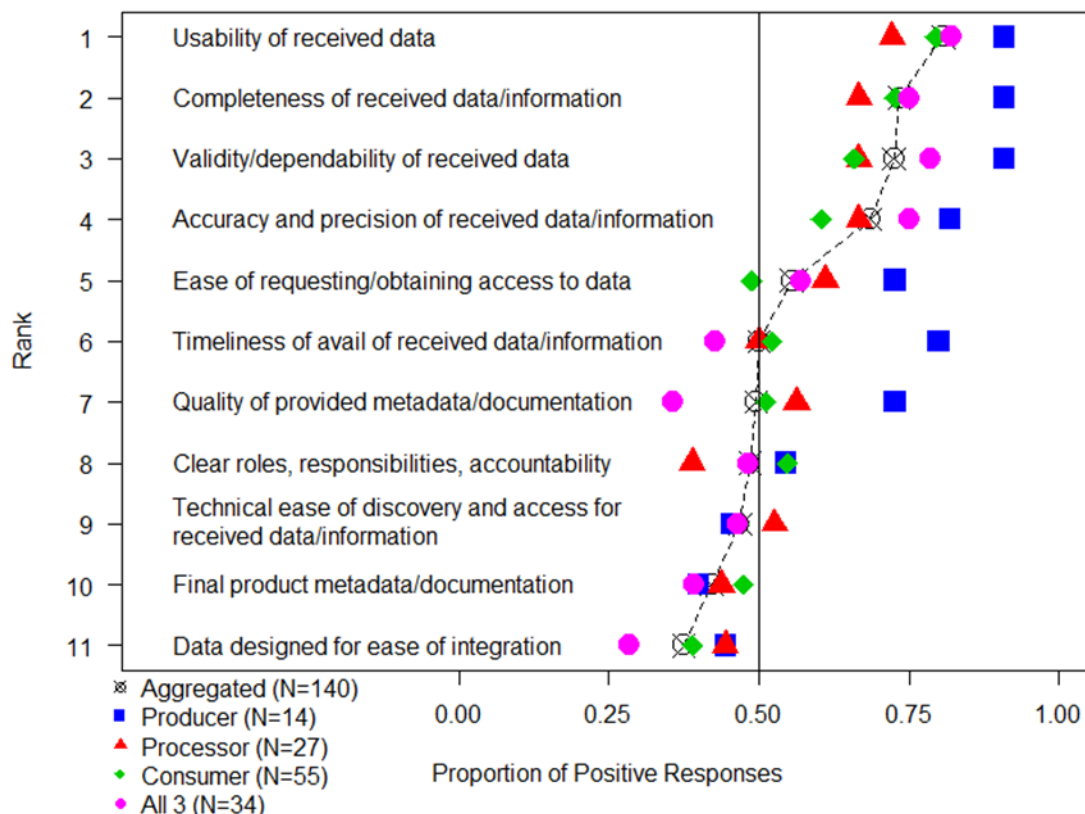


Figure B9. The proportions of aggregated positive responses regarding aspects of information management at respondent's organization in the context of data consumption. Responses are organized by Producer vs. Processor vs. Consumer. This graph shows similar responses across respondents; however, producers have higher proportions of positive responses than their counterparts.

Importance of Modernization

The graphs below show responses of (1) those associations with fishery-dependent vs. fishery-independent data, (2) NOAA vs. Partners demographics, and (3) Producers vs. Processors vs. Consumers of fisheries information. The respondents were asked to rate aspects of modernization at their organization with the following scale: **(0= No opinion, 1= Not Important 2= Somewhat Important 3= Important 4= Very Important)**. The figures below show the proportion of 'positive responses', those who chose 'important' or 'very important'.

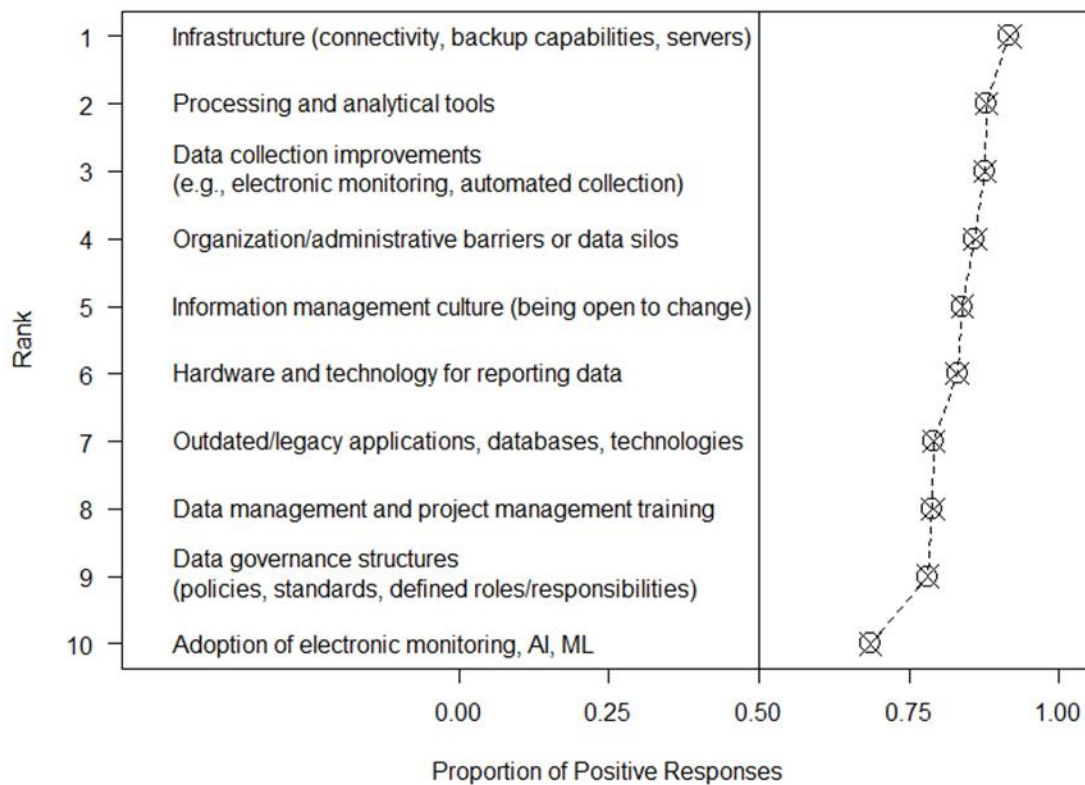


Figure B10. The proportions of aggregated positive responses regarding modernization aspects at the respondent's organization. There is a similar proportion of positive responses across all aspects of modernization.

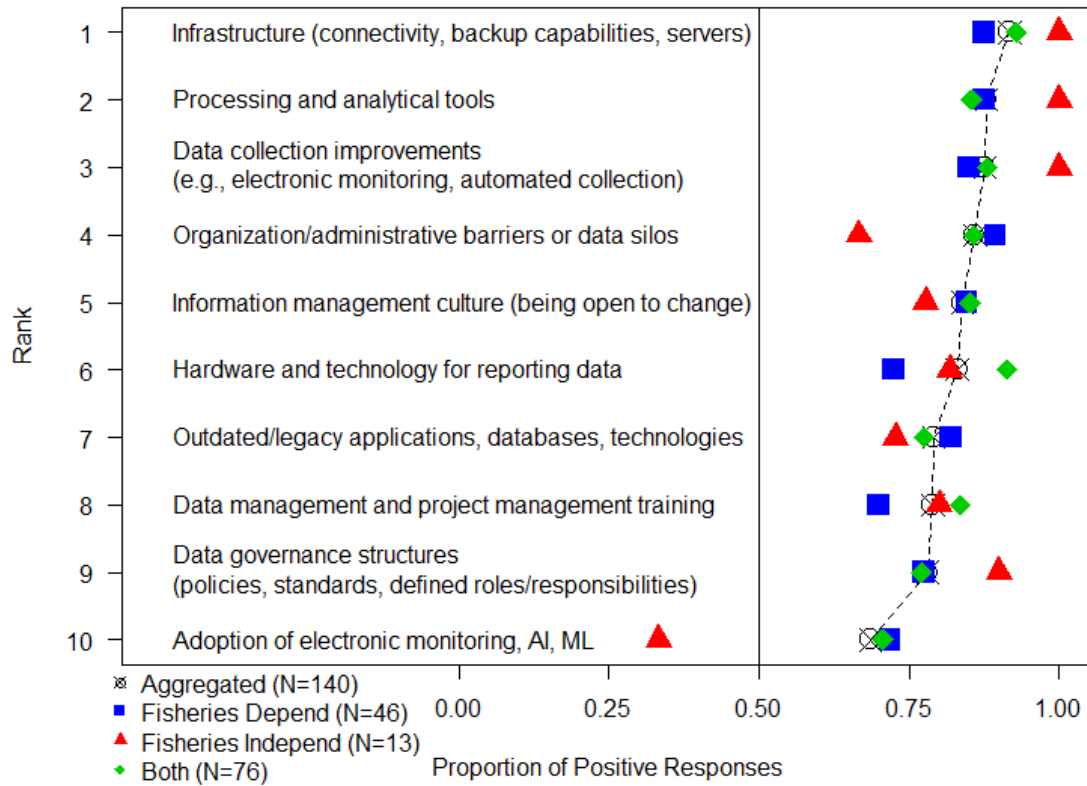


Figure B11. Proportions of aggregated positive responses regarding modernization aspects at the respondent's organization. Responses are organized by the associations to fishery-dependent vs. fishery-independent data. This graph shows similar responses across respondents; however, fishery-independent respondents have varying proportions of positive responses.

Score the importance of modernization to the following areas

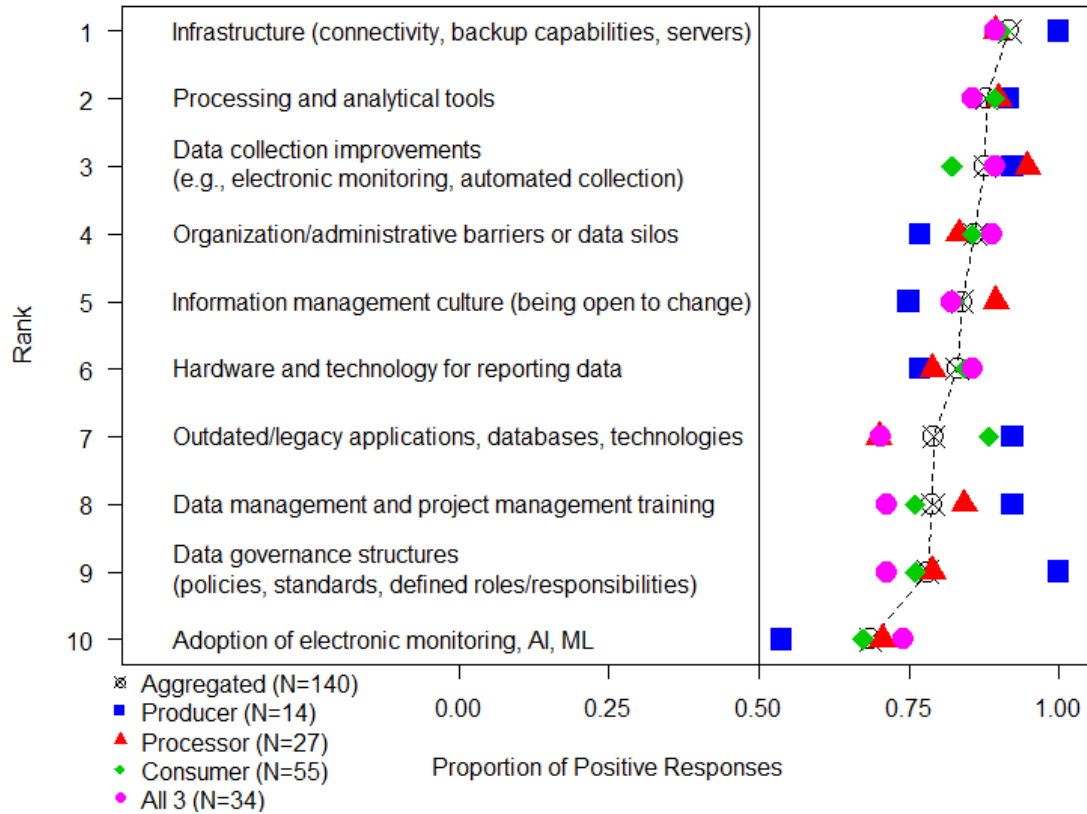


Figure B12. Proportions of aggregated positive responses regarding modernization aspects at the respondent's organization. Responses are organized by the associations to Producer vs. Processor vs. Consumer. This graph shows generally similar scores across modernization aspects. However, producers responded with the fewest positive responses toward adoption of electronic monitoring and AI. In contrast, producers responded with the most positive responses for data governance structures than their counterparts.

Score the importance of modernization to the following areas

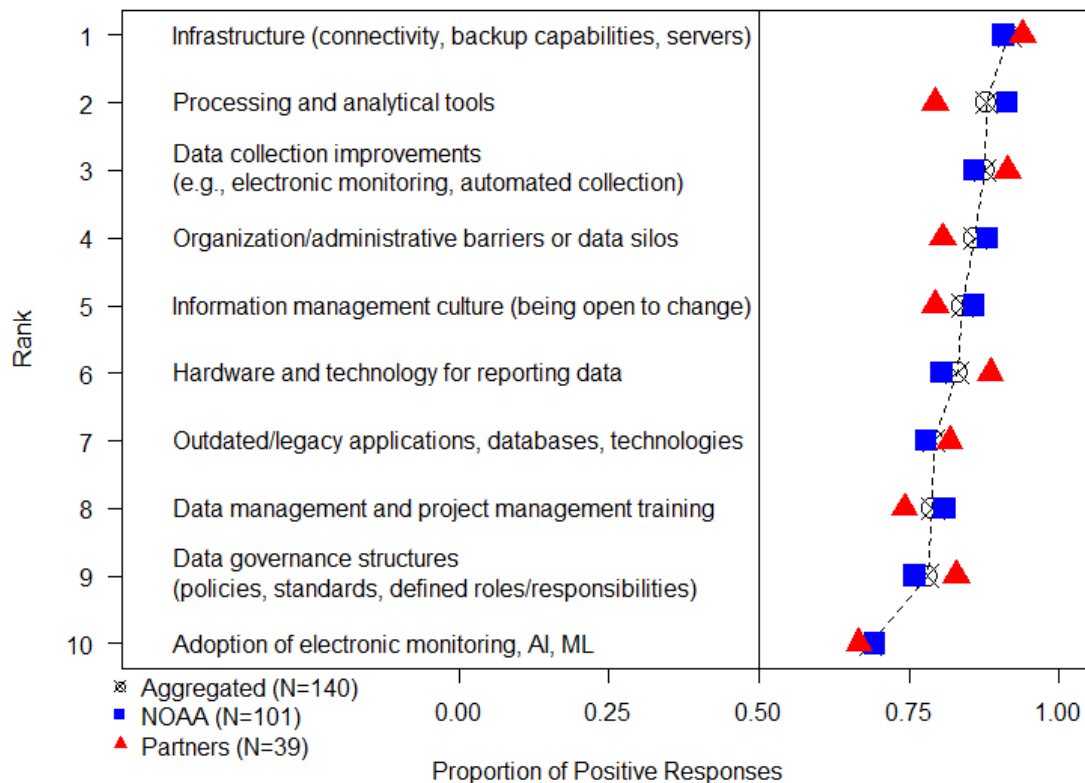


Figure B13. Proportions of aggregated positive responses regarding modernization aspects at the respondent's organization. Responses are organized by the associations to NOAA vs. Partners. In general, responses from NOAA and its partners are closely aligned with one another and the aggregated responses.

Appendix C. Driving Documents

A number of legislative, executive, Department of Commerce, NOAA, NOAA Fisheries, and external drivers define and offer guidance on how Federal agencies manage government data, make it accessible, and modernize our systems. Here are summaries of the principal drivers of our modernization efforts.

LEGISLATIVE DRIVERS

1. Privacy Act | 1974

[Access Document Here](#)

The Privacy Act of 1974, as amended, 5 U.S.C. § 552a, establishes a code of fair information practices that governs the collection, maintenance, use, and dissemination of information about individuals that is maintained in systems of records by Federal agencies.

2. Magnuson-Stevens Fishery Conservation Act and Management Act | 2007

[Access Document Here](#)

Summary

The Magnuson-Stevens Act was last amended in 2007, and is the primary law governing marine fisheries management in U.S. Federal waters. This act protects the rights of fishermen and their data.

3. Modernizing Government Technology Act | 2017

[Access document here](#)

Summary

This memorandum provides guidance to all agencies regarding the necessary planning for Technology Modernization Fund activities. It encourages agencies to consider the adoption of commercial technology solutions.

4. Federal Data Strategy | 2018

[Access website here](#)

Summary

The mission of the Federal Data Strategy is to fully leverage the value of Federal data for mission, service, and the public good by guiding the Federal Government in practicing ethical governance, conscious design, and a learning culture. The four main areas for exploration are:

1. Decision Making and Accountability
 2. Enterprise Data Governance
 3. Access, Use, and Augmentation
 4. Commercialization, Innovation, and Public Use
-

5. Geospatial Data Act | 2018

[Access document here](#)

Summary

This bill is designed to facilitate and support geospatial data development, sharing, and coordination across Federal agencies and partnerships with state and local governments, towards a more robust National Spatial Data Infrastructure

Specific agency responsibilities are covered in [Section 759](#).

6. Foundations for Evidence-Based Policy Making Act | 2018

[Access document here](#)

Summary

All Federal data are open by default (subject to legal exemptions), distributed under an open license, and are to be published as machine-readable. Each agency must maintain a comprehensive data inventory for all data assets; establish data governance structures; and publish an Open Data Plan.

6.1 Guidance on the Federal Evidence-Based Policymaking Act

[Access document here](#)

Summary

The FEBPA Phase 1 implementation provides guidance on how agencies can prepare to use learning agendas in their decision-making processes, the establishment of Chief Data Officers and data governance councils, and steps toward agency open data plans.

7. Guidance on Information Quality Act | 2019

[Access Information Quality Act here](#)

[Access IQA guidance here](#)

Summary

This memo changes the definition of what is considered influential scientific information and broadens the scope to include data. OCIO is currently in the process of updating NOAA's IQA policy to meet the changes.

EXECUTIVE DRIVERS

8. US Office of Management and Budget Memorandum, M-13-13 | 2013

[Access Document Here](#)

This Memorandum requires agencies to collect or create information in a way that supports downstream information processing and dissemination activities. This includes using machine readable and open formats, data standards, and common core and extensible metadata for all new information creation and collection efforts. It also includes agencies ensuring information stewardship through the use of open licenses and review of information for privacy, confidentiality, security, or other restrictions to release. Additionally, it involves agencies building or modernizing information systems in a way that maximizes interoperability and information accessibility, maintains internal and external data asset inventories, enhances information safeguards, and clarifies information management responsibilities.

9. US Office of Management and Budget Circular A-130: Managing Information as a Strategic Resource | 2016

[Access Document Here](#)

This Circular establishes general policy for the planning, budgeting, governance, acquisition, and management of Federal information, personnel, equipment, funds, IT resources and supporting infrastructure and services.

10. Federal Government Data Maturity Model | 2017

[Access Document Here](#)

Summary

The Federal Government Data Maturity Model designed by the National Institute of Standards and Technology. This matrix was used as a base to build a proposed NMFS data maturity model.

11. President's Management Agenda | 2018

[Access document here](#)

Summary

The President's Management Agenda is a long-term vision for modernizing the Federal Government in key areas that will improve the ability of agencies to deliver mission outcomes, provide excellent service, and effectively steward taxpayer dollars on behalf of the American people. The Technology Modernization Fund and its process are explained.

Three priorities guide the Administration’s efforts to modernize Federal IT:

- Enhancing Mission Effectiveness by improving the quality and efficiency of critical citizen-facing services, including through the increased utilization of cloud-based solutions
- Reducing Cybersecurity Risks to the Federal Mission
- Building a Modern IT Workforce

Agency IT modernization plans must be focused on delivering better service to the public, and in doing so should be developed in furtherance of these priorities. This will result in building and maintaining a modern, secure, and resilient IT, which improves the lives of the American public.

12. Executive Order on Maintaining American Leadership in Artificial Intelligence | 2019

[Access document here](#)

Summary

This Executive Order states the Federal Government’s charge to maintain leadership in artificial intelligence and facilitate its research and development.

Followup guidance will be provided that shall inform the development of regulatory and non-regulatory approaches by agencies regarding technologies and industrial sectors that are either empowered or enabled by AI, and that advance American innovation while upholding civil liberties, privacy, and American values and consider ways to reduce barriers to the use of AI technologies.

13. Federal Cloud Computing Strategy | 2019

[Access strategy here](#)

Summary

To keep up with the country’s current pace of innovation, the current administration has placed significant emphasis on utilizing IT modernization to improve the services the federal

government provides to the American people. Through an Executive Order, President Trump directed the creation of a report on the modernization of federal IT. This report identified over 50 tasks that improve citizen-facing services, accessibility, and maintain cybersecurity. This administration developed Cloud Smart, a new strategy for agencies to adopt cloud solutions that streamline transformation and embrace modern capabilities.

14. GAO Report on Information Technology in the Workforce | 2019

[Access Document Here](#)

Summary

This report was produced by the Government Accountability Office after conducting a government-wide review of IT workforce planning. GAO found most agencies minimally implemented or did not implement five other workforce planning activities.

DEPARTMENT OF COMMERCE DRIVERS

15. U.S. Department of Commerce Strategic Plan | 2018-2020

[Access document here](#)

Modernization Summary

Modernization of federal IT is a high priority. IT modernization also creates opportunities for significant acquisition savings through economies of scale. The Department of Commerce (DOC) plans to leverage American innovation through the increased use of commercial technology and move to a cost-effective and secure infrastructure. The DOC is developing action plans to maximize secure use of commercial cloud computing, modernize and manage applications, and securely maintain legacy systems. Technology modernization will allow for a shift in resources from supporting back-office functions to improving the customer experience.

NOAA DRIVERS

16. NOAA Administrative Order (NAO) 212-15 | 1991

[Access Document Here](#)

This NOAA Administrative Order (NAO) establishes the Department of Commerce (DOC) National Oceanic and Atmospheric Administration (NOAA) Environmental Data Management Policy. This policy provides high-level direction that guides procedures, decisions, and actions regarding environmental data and information management throughout NOAA.

17. NAO 216-112: Policy on Partnerships in the Provision of Environmental Information | 2007

[Access Document Here](#)

The NOAA Policy on Partnerships in the Provision of Environmental Information strengthens the partnership among government, academia, and the private sector, which provides the nation with high quality environmental information.

18. NOAA's Next Generation Strategic Plan | 2010

[Access Document Here](#)

This Plan represents NOAA's assessment of the highest priority opportunities for NOAA to contribute substantially to the advancement of society and fulfill the NOAA mission.

19. NOAA's Environmental Data Management Framework | 2013

[Access Document Here](#)

The NOAA EDM Framework includes Principles, Governance, Resources, Standards, Architecture, and Assessment that apply broadly to many classes of data. The concept of the Data Lifecycle is introduced and separated into planning and production, data management, and data usage activities.

20. NOAA Strategies | 2020

[Access Strategies Here](#)

Summary

NOAA's new strategies in five key science and technology (S&T) focus areas will guide transformative advancements in the quality and timeliness of NOAA's products and services across our mission areas. Our strategies in the fields of (1) Unmanned Systems (UxS), (2) Artificial Intelligence (AI), (3) Cloud Computing, the use of advanced methods to analyze material such as DNA, RNA, or proteins, called (4) 'Omics, and (5) Data, will help us more efficiently and effectively adopt the breakthrough S&T applications to help deliver the world's best weather forecasts and to grow the American Blue Economy.

20.1 NOAA Unmanned Systems Strategy | 2020

[Access Document Here](#)

The purpose of the National Oceanic and Atmospheric Administration (NOAA) Unmanned Systems Strategy is to dramatically expand the collection and utilization of critical, high accuracy, and time-sensitive data by increasing the application and use of unmanned aircraft and marine systems (together, "unmanned systems" or "UxS") in every NOAA mission area to improve the quality and timeliness of NOAA science, products, and services.

20.2 NOAA Artificial Intelligence Strategy | 2020

[Access Document Here](#)

The National Oceanic and Atmospheric Administration (NOAA) Artificial Intelligence (AI) Strategy will dramatically expand the application of artificial intelligence (AI) in every NOAA mission area by improving the efficiency, effectiveness, and coordination of AI development and usage across the agency.

20.3 NOAA 'Omics Strategy | 2020

[Access Document Here](#)

Advances in ‘omics methodologies can improve the ability to monitor and understand the biological communities of the oceans and Great Lakes. ‘Omics approaches can be faster, cheaper, less invasive, and can provide more information than traditional methods, and thus result in improved delivery of the NOAA’s products and services.

20.4 NOAA Cloud Strategy | 2020

[Access Document Here](#)

This document defines a strategy to guide NOAA’s adoption and utilization of cloud services. The strategy assumes change, and requires a new mindset for modernizing NOAA’s IT environment.

20.5 NOAA Data Strategy | 2020

[Access Document Here](#)

The purpose of the NOAA Data Strategy is to dramatically accelerate the use of data across the agency and with other key partners, maximize openness and transparency, deliver on mission, and steward resources while protecting quality, integrity, security, privacy, and confidentiality.

NOAA FISHERIES DRIVERS

21. Regional Survey of Information System Modernization Opportunities | 2017

[Access Document Here](#)

Summary

This memo to Chris Oliver displays the results of 45 structured interviews conducted by the Net Gains Alliance to identify regional modernization needs. Interviewees ranged from managers, scientists, conservationists, to other experts from all regions of the US. It should be noted that the information from this survey was collected in 2016, and although the

results show depth and interest in data modernization, each idea or project would need development to make sure that they are still viable.

22. NOAA Fisheries Priorities and Annual Guidance | 2019

[Access document here](#)

Strategic Goals

1. Amplify the economic value of commercial and recreational fisheries while ensuring their sustainability.
2. Recover and conserve protected species while supporting responsible fishing and resource development.
3. Improve organizational excellence and regulatory efficiency.

Priorities

1. Modernize and streamline our fishery information systems and enhance data sharing and accessibility
 2. Advance effective and practical electronic appropriate technologies to improve the collection of fishery-dependent and fishery-independent data.
 3. Improve science focus on real-time current management issues and data needs.
-

EXTERNAL DRIVERS

23. Improving Net Gains | 2017

[Access document here](#)

Summary

The “Improving Net Gains” report was prepared by the Fishing Data Innovation Taskforce, a coalition of experts from the commercial and recreational fishing sectors, seafood industry, conservation community, and technology industry and was informed by interviews with former government officials, leaders in the fishing industry and others. This report identifies specific, concrete steps that can help advance data modernization.

Appendix D. Workshop Abstracts

Importance, Challenges, and Success of Partnerships

Mike Cahall¹

¹ Atlantic Coastal Cooperative Statistics Program, Arlington, VA 22201

The Atlantic Coast Cooperative Statistics Program was created in 1995 to standardize fisheries data collection and management practices and provide a centralized information system to house coastal fisheries-dependent data. Since then, ACCSP has worked collaboratively with its Partners to create modern, integrated data collection systems using forward thinking and best practices. Today, ACCSP has dramatically improved the quantity, quality, accuracy and timeliness of these data and continues to work with its Partners to meet the challenges and needs of its stakeholders.



Figure D1. The Atlantic Coast Cooperative Statistics Program Partners.

NOS Information Management Modernization

Tyler Christensen¹, Kim Valentine¹, Tony LaVoi¹

¹ NOAA National Ocean Service, Silver Spring, MD 20910

NOS is a very diverse line office, with a wide range of mission focus and data assets. Data management is coordinated at the Line Office level through the NOS ACIO's office, including a data management working group. Recent successes include a comprehensive data inventory, PARR assessment, migration of the metadata catalog to InPort, and some efforts to migrate to the cloud. We look forward to the opportunities presented by new legislation and policies, and especially to increased coordination with data management working groups in NESDIS, OAR, and NMFS.

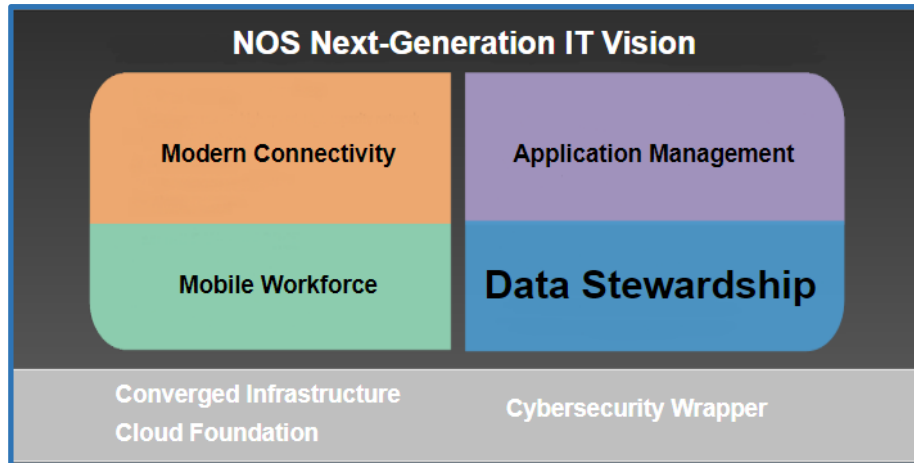


Figure D2. Next Generation National Ocean Service IT vision.

Data Rescue and Accessibility

Julie Defilippi Simpson¹

¹ Atlantic Coastal Cooperative Statistics Program, Arlington, VA 22201

Data consolidation and accessibility is at its core about partnerships. Standardization is the basis of data consolidation and is only achievable through a collaborative process. Interaction with and among data providers leads to standards that provide guidance and flexibility and allows for the integration of multiple data sets into a single homogenized, regional data set. Processing of these data is complex and dependent upon an understanding of the data that can only come from the data providers. Process documentation and metadata are necessary throughout the process. These data must be accessible in public and confidential formats that are user-friendly. Working together with our partners and fellow FINs has been an important part of building our online Data Warehouse.



Figure D3. The Atlantic Coast Cooperative Statistics committee-based structure to collaboratively approach data consolidation.

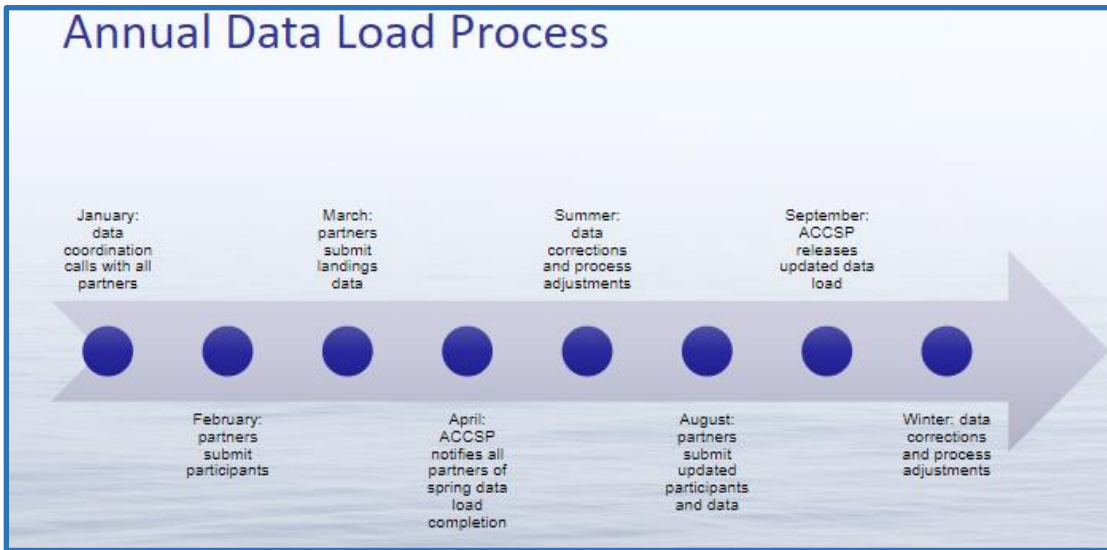


Figure D4. The Atlantic Coast Cooperative Statistics Program’s annual data loading process.

A data-centric approach to modernization for NMFS and NOAA

Ed Kearns¹

¹ NOAA CIO, Silver Spring, MD 20910

Many Federal agencies such as NOAA are attempting to modernize their approaches to how they execute their missions. Commercial cloud technologies have fallen in price and offer flexible, scalable approaches to the storage and computing needs of those agencies. However, NOAA and other Federal agencies are also facing governance and utilization challenges related to their data assets that have large implications for the adoption of new IT and science-focused technologies. To help with these challenges to enable the maximum value to be realized from Agency data assets, OMB has led the development of the Federal Data Strategy. Congress has also passed the Evidence Act and the Geospatial Data Act this year, which codify many of NOAA's existing data practices and policies but also present additional opportunities. The presentation will describe how NMFS may want to leverage these efforts to take a strategic approach to its data challenges.



Figure D5. The Federal Data Strategy provides guidance on leveraging data as a strategic asset.

Modernization Needs for NOAA Fisheries Information Management

Patrick Lynch¹

¹ NOAA National Marine Fisheries Service, Silver Spring, MD 20910

NMFS has a proven track record of supporting sustainable fisheries management. Through comprehensive monitoring, research, and stock assessment analyses, NMFS is able to provide high quality scientific advice to fishery managers that helps to satisfy legal mandates and facilitate sustainable fisheries. However, challenges regarding data management can serve as a bottleneck within the science advisory process that limits efficiency. These limitations are nontrivial, because the management needs for scientific advice exceed NMFS scientific capacity. However, improvements to information management could help to better meet those needs. This presentation highlighted information management modernization needs and summarized the results of a questionnaire distributed to NMFS stock assessment scientists across all science centers. Overall, information management, and the efficiency by which scientists can develop advice, varies substantially across regions, in part due to external factors (e.g., the number of contributing partners). In some regions, data acquisition and processing require the majority of an analyst's time, whereas more streamlined systems offer more time for developing advice and advancing the science. There is clearly a need for information modernization to support stock assessments and science advisory processes, and efforts are underway across regions. However, should additional resources become available, regions with the least efficient frameworks may represent the highest priorities for investment.

Data Modernization in Southeast Fisheries Management: An overview of management drivers for fisheries information modernization

Jessica Stephen¹

¹ NOAA National Marine Fisheries Service, Southeast Regional Office, St Petersburg, FL 33701

The southeast region faces a few challenges that could be assisted through potential electronic technologies and data modernization. The Southeast has the unique distinction of working with three Fishery Management Councils and 11 different states and territories. Furthermore, management faces different objectives for the large commercial and recreational fisheries. In some instances, the recreational fisheries are the primary harvesters of the fish stock. Some key factors to management decisions with respect to data modernization include improving timeliness of data collection and sharing, data quality increases through electronic technologies, reduced duplicative reports through partnership and data sharing, and the potential of at-sea data transmissions. Some key considerations with modernization for our region include system maintenance, storage capacity, data access, data sharing, and program development.

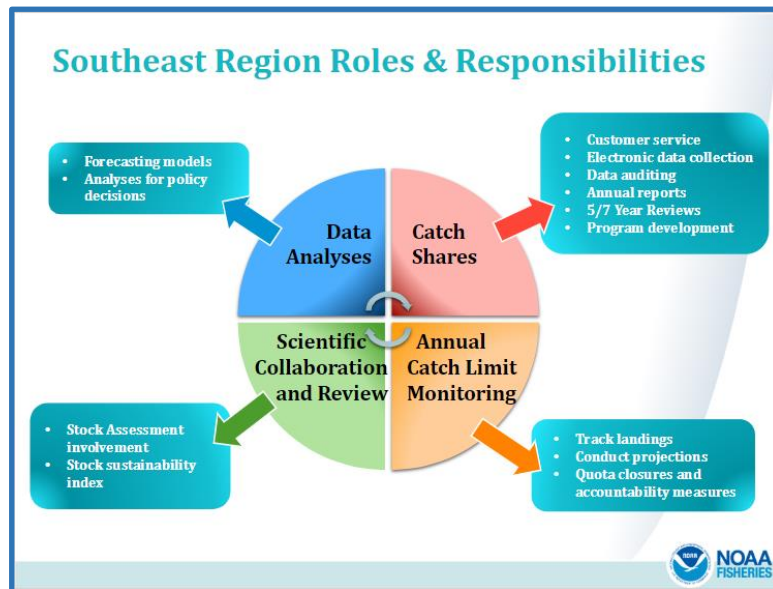


Figure D6. NMFS Southeast Region Roles and Responsibilities.

Integrating environmental and fishery data to resolve fish and fishery trends

Jordan Watson¹

¹ NOAA National Marine Fisheries Service, Alaska Fisheries Science Center, Juneau, AK 99801

Making use of big data in fisheries can be difficult due to disparate spatial and temporal scales. But aggregating data to similar scales and merging datasets can provide critical context and understanding to changes in fishery species compositions and fisher responses to environmental dynamics. However, onerous integration steps can hinder the use of these data for many fisheries applications. An AFSC/AKFIN team automated data integration protocols to provide near real-time sea surface temperatures linked to Alaska fish tickets and other spatially-explicit fishery data. We are expanding this effort to link vessel monitoring system and observer data with environmental and operational variables to improve the access, reliability, and consistency of these data.

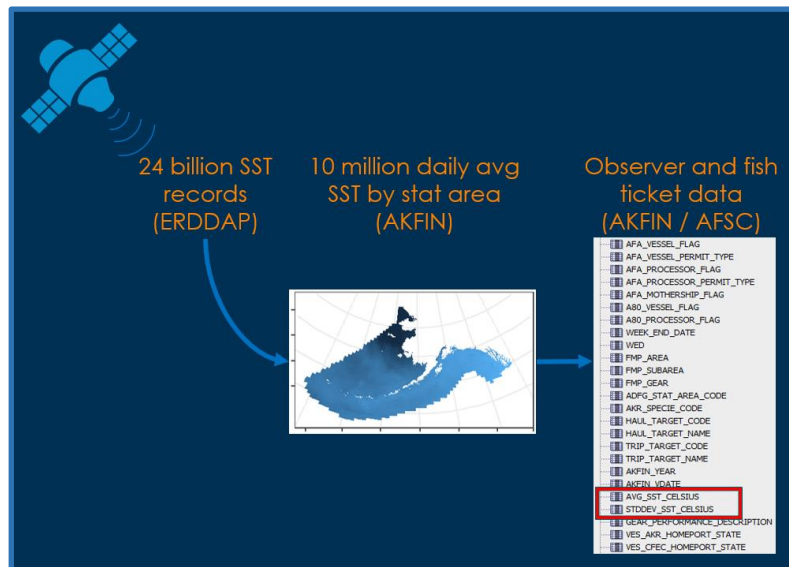


Figure D7. Integration of ERDAPP and AKFIN data enhance data availability and discovery at AKFIN and AFSC.

Appendix E. Speaker Bios

Cahall, Mike

Mr. Michael Cahall retired in May as the Director of the Atlantic Coast Cooperative Statistics Program (ACCSP) after serving in that capacity for 13 years. During his tenure, the ACCSP grew dramatically and now serves as a critical component of Atlantic coastal fisheries-dependent data collection, storage and dissemination. Prior to being Director, Mr. Cahall served as the Data Systems Manager where he designed many of the basic systems that have been expanded and are still in use today. Before joining the ACCSP, Mr. Cahall worked in Health Care Information Systems as a Project Manager and Database Administrator and as a Computer Specialist at the National Weather Service in the Engineering Branch of the Office of Systems Operations. Mr. Cahall holds a degree in Music as well as a paramedic certification and is both an active musician and volunteer health care provider.

Christensen, Tyler

Tyler Christensen is one of the data management coordinators for NOS, sitting in the NOS ACIO's office. She chairs the NOS Data Management Working Group and is the metadata lead. Recently, she has been helping to coordinate implementation of the Geospatial Data Act and is the NOAA alternate rep to the OSTP Subcommittee on Open Science. Before coming to NOS, she worked in the German Remote Sensing Data Archive, the NOAA Coral Program, and NESDIS. She holds a master's degree in marine biology from the Virginia Institute of Marine Science.

Defilippi Simpson, Julie

Julie Defilippi Simpson has worked for the Atlantic States Marine Fisheries Commission for 12 years. She is the ACCSP Deputy Director and Data Team Lead. Julie's primary role includes overseeing the annual RFP process, staffing the Operations Committee, representing ACCSP on the Fisheries Information System program, and providing guidance for all data related activities. This includes responsibility for the commercial and biological data, data collection and warehousing projects, user interface projects, and data dissemination activities.

Hare, Jon

Dr. Jon Hare is the Science and Research Director of the Northeast Fisheries Science Center. He oversees science activities related to the NMFS mission in the Northeast region including fisheries, aquaculture, protected species, habitat, and ecosystem science. Before becoming an administrator, Jon was a research scientist working to understand the interactions

between oceanography and fisheries populations with a goal of contributing to assessments and management. He is also an expert on the effect of climate change on marine fisheries and the implications to coastal communities.

Kearns, Ed

Dr. Ed Kearns is the interim Chief Data Officer for the U.S. Department of Commerce, overseeing governance and management of its data assets. As NOAA's first Chief Data Officer in 2017, he has developed strategies and practices for NOAA's data assets. Ed promotes new uses and wider understanding of Federal data through new partnerships and technologies, such as the [NOAA Big Data Project](#). For the White House's [Leveraging Data as a Strategic Asset](#) initiative, he has helped develop the new [Federal Data Strategy](#). Previously, Ed led climate data and archive activities for NOAA; guided Everglades restoration for the National Park Service; and calibrated NASA satellite products as a professor at the University of Miami. He earned a Ph.D. in Physical Oceanography from URI as well as a B.S. in Physics and Marine Science from the University of Miami.

Lynch, Patrick

Dr. Patrick Lynch works in the Office of Science and Technology as Chief of the Assessment and Monitoring Division (ST4). Patrick oversees the Division's Fisheries and Protected Species Science branches, which collectively support agency at-sea resource surveys, fish and protected resource science and stock assessments, fisheries observer programs, a sea bird program, cooperative research, and the independent peer review of NMFS' science products and programs. Patrick joined ST in 2013 as the National Stock Assessment Coordinator, and in that position oversaw the establishment of ST's National Stock Assessment Program, for which he has been serving as the program's lead prior to his current position.

Malik, Mashkooor

Mashkooor Malik is a physical scientist with NOAA Office of Ocean Exploration and Research. His background is in Hydrographic Surveying. He completed his M.S. in Ocean Engineering from the University of New Hampshire in 2005 and B.Sc. in Marine Sciences from Karachi University Pakistan in 1998. His research interests include data visualization, and the merging of video and acoustic data.

Parsons, Rost

Dr. Rost Parsons is the Deputy Director of NOAA's National Centers of Environmental Information's Center for Coasts, Oceans and Geophysics (CCOG). CCOG's 130 scientists are

globally recognized as the premier providers of geophysical, oceanographic, coastal, space weather, and marine ecosystem foundational data sets and information. Dr. Parsons is a physical oceanographer and has worked closely with NMFS in the past as a member of the National IEA Steering Committee.

Ryznar, Bob

Bob Ryznar is a Program Manager with Pacific States Marine Fisheries Commission (PSMFC) for the Alaska Fisheries Information Network (AKFIN) and Pacific Fisheries Information Network (PacFIN) programs. Bob has spent the majority of his career solving fisheries data management problems and building robust and integrated data warehouses. Bob enjoys running and sour candy. He believes the keys to a successful project are breaking it down into manageable tasks, building trust amongst the stakeholders, and showing results early. Using this approach, Bob has helped modernize various fisheries data systems, from converting mainframe systems into relational database solutions early on to, overhauling the approaches to stock assessment by getting desktop solutions into an accessible, standardized, transparent, and centralized database.

Stephen, Jessica

Dr. Jessica Stephen is the branch manager for the Limited Access Privilege Program/Data Management (LAPP/DM) branch in the Southeast region. The LAPP/DM branch is responsible for managing catch shares (LAPPs) and providing analytical support for amendments to fishery management plans. Jessica runs three catch share programs, conducting and overseeing analytic work relating to ongoing management changes, coordinating with various branches, divisions, and line offices in NMFS. In addition, she works closely with ACCSP's social/economic branch, permits branch, IT branch, law enforcement, and counterparts in the Science Centers. Jessica represents the regional office for the Electronic Technologies (ET) policy group, ET professional specialty group, Fisheries Information Systems' (FIS) Program Management Team, and Catch Share working group. In Jessica's role as the regional ET liaison, she works closely with other regions in the development of joint ET projects (e.g., for-hire electronic reporting), and participates in various ET or statistical workshops.

Watson, Jordan

Jordan Watson is a mathematical statistician at the Alaska Fisheries Science Center in Juneau, AK. His current work is primarily focused on characterizing factors that describe and affect fisher behavior, with particular interest in climatic drivers and implications for bycatch. He has a B.S. in chemistry from the University of California Santa Barbara, an M.S.

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White, Geoff

Geoff White is the current Director of ACCSP with over 20 years of experience in fisheries partnerships and fisheries data management. He has steered the transition to state conduct of the MRIP Access Point Angler Intercept Survey, including a move to tablet data collection, developed portions of ACCSP's web query interface, and served several years as the sysadmin and Oracle DBA. ACCSP partnerships, data standards, data flow, and projects strive for efficiency through collaboration.

Appendix F. Workshop Participant List

Participant list for the FIMM Workshop. The asterisk (*) indicates that a participant served as a planning committee member; italicized names indicate remote participation; (F) and (N) indicate the roles of facilitators and notetakers respectively.

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