# NOAA

Integrated Ocean Observing System (IOOS) Program

## Data Integration Framework (DIF)

## Master Project Plan

(Version 1.0)

November 8, 2007

# Revisions

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| 1.1 | | |
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| 1.3 | | |
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# Review & Approval

### Project Plan Review History

| Reviewer | Version Reviewed | Signature | Date |
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| **Christopher Moore/IOOS** | 0.1 | | 9/12/07 |
| **Original IPT members** | 0.1 | | 9/24/07 |
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| **Charles Alexander** | 0.1 | | 11/2/07 |
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# 1 Project Definition

## 1.1 Overview

In December, 2006, the NOAA Executive Council and NOAA Executive Panel approved the formation of NOAA's IOOS Program within the National Ocean Service. This included approval for the IOOS Program to develop a Data Integration Framework (DIF) project with a nominal duration of three years, from February 1, 2007 to February 1, 2010. The DIF is limited in scope and scale to the integration of data from sources of five (5) core IOOS variables to address the requirements of four (4) ocean decision-support tools that span multiple NOAA mission goals. The DIF project objectives are:

- Validate the premise that integrated data has value that can be measured. This premise will be tested using 5 IOOS core ocean variables, from NOAA and non-NOAA sources, and 4 specific NOAA decision-support tools/models.
- Utilizing the principles of IOOS Data Management and Communications (DMAC), develop a methodology to improve upon existing ocean data integration efforts that will facilitate flexibility and extensibility to other variables, systems and decision-support tools.
- Achieve improved integration of selected data sets by identifying, adopting, and adapting community-developed standards for data content, metadata, quality control, and transport and deploying these standards at selected data sources serving the 4 decision-support tools.
- Maintain the DIF for a period of three years, from project inception, to conduct adequate performance monitoring and assessment for evaluating and measuring progress.
- Provide a set of lessons learned, draft standards, and other outputs that will inform the longer-term strategic ocean data integration efforts to leverage the DIF experience for the benefit of NOAA and the Nation.

Existing internal (NOAA) and external (non-NOAA) data integration and management capabilities will be leveraged to develop a methodology that will provide enhanced data access and data management services to four designated NOAA decision-support tools. To design, build and implement the DIF, the NOAA IOOS Program will utilize existing capacity and expertise resident in NOAA. As needed, and subject to budget availability, resources will be provided to support these contributors as they help develop the DIF. Project teams and affiliated working groups composed of cross Line Office and Goal Team representatives will design, carry out, or direct the technical work and building of DIF components, and will be involved in the testing and evaluation of the DIF. The National Weather Service's System Engineering Center (SEC) is providing support to the NOAA IOOS Program, the project teams, and the working groups. Recently after a joint meeting of the NOAA Data Management Integration Team and DIF project management and staff, the DIF was proposed to be a pilot project of NOAA's Global Earth Observation Integrated Data Environment (GEO-IDE) – see http://www.nosc.noaa.gov/dmc/swg/swg_docs.html for the current GEO IDE CONOPS that is due to be updated. Therefore, the DIF will not only be consistent with, but will support the objectives of NOAA's target architecture. The DIF will follow NOAA IT security and data management guidelines.

Throughout the duration of the project, DIF progress and plans will be shared with appropriate NOAA Councils and other relevant NOAA organizations as well as with other Federal and non-federal IOOS partners and participants. The NOAA IOOS Program Office, guided by input from the project teams, will track the progress and plans of similar efforts within the ocean community to assure compatibility and contribution of the DIF to the national IOOS to the maximum extent possible. During the project period, documentation will be prepared by the NOAA IOOS Program Office, based on project results, lessons learned, best practices, etc., to support an analysis of alternatives. This analysis is expected to inform NOAA management in deciding whether at the end of the project period the DIF effort should continue and expand, should be discontinued, and if discontinued, if some other option for data integration and management should be pursued.

## 1.2 Scope

The DIF is focused on the integration of data from selected sources of five core IOOS variables. The requirements of four ocean decision-support tools operated within NOAA will be used to guide the design and development of the DIF, and the value and success of the resulting integration will be measured and evaluated by its ability to enhance the efficiency and/ or effectiveness of these tools. The core IOOS variables are **seawater temperature**, **salinity**, **currents**, **ocean color**, and **sea/water level** and the decision-support tools are for **Coastal Inundation**, **Hurricane Intensity**, **Integrated Ecosystem Assessments**, and **Harmful Algal Blooms**. The variables were selected based on the number of readily available data sources and their anticipated relevance to the decision-support tools. The four decision-support tools were selected because they address critical environmental issues aligned with NOAA mission goals.

Integration within the DIF means improving the way the selected sources of the five variables are made available to the four decision-support tools through the consistent application of community-based standards and protocols, such as for data content and transport. By adopting, adapting, or expanding existing standards and other capacities and capabilities for data management services, or as a last resort developing new ones, the DIF will formalize a standards-based common data sharing infrastructure that is expected to facilitate and improve data integration of ocean variables across NOAA Line Offices. Sources of the five core variables will be selected based on the requirements of the decision-support tools, and are expected to include a variety of NOAA and some non-NOAA observation systems and platforms. Additional variables and systems may be included, if feasible, given timelines and budget constraints. Throughout the project period, all phases of the DIF will be designed, developed, built and tested to assure that the project objectives are being addressed.

The NOAA IOOS Program Office anticipates that the standards, best practices, and other protocols that are selected to establish the DIF project will be of use to other IOOS partners. By employing existing community standards to design and build the DIF, it is expected that the common data sharing infrastructure that is developed will be extensible to not only additional variables, data sources, and systems, but to the larger IOOS community. To ensure this, the DIF will use the above noted philosophy of identifying, adopting and adapting existing community-based data standards and protocols, as outlined in the National Office for Integrated and Sustained Ocean Observations' (Ocean.US), DMAC plan published in March, 2005 (http://dmac.ocean.us/index.jsp). Guidance provided by the NOAA Data Management and Integration Team (DMIT) (http://www.nosc.noaa.gov/dmc/swg/swg_docs.html) concerning data management functions and standards will also be considered. An additional product of the DIF that speaks to this extensibility will be the submission of the identified DIF standards to the Ocean.US DMAC standards process (http://ioosdmac.fedworx.org) as well as to the NOAA standards process managed by the DMIT

(https://www.nosc.noaa.gov/dmc/swg/wiki/index.php?title=NOAA_GEO-IDE_Standards_Process).

## 1.3 Deliverables

Table 1 identifies major deliverables for the DIF, the estimated delivery dates. More on the associated milestones is in Section 4, and greater specificity on milestones and sub-tasks can be found in the Project Management Plan for the DIF, a separate document available on a case-by-case basis upon request from the project manager. The Project Management Plan is developed based on information described in implementation activity and work plans developed by the DIF project staff and the Integrated Products Team (IPT), as well as in systems engineering documentation developed for the DIF project.

**Table 1 – DIF Project Major Deliverables**

| Deliverable | Date |
|---|---|
| Propose normative minimum data content standards, including necessary supporting vocabularies and content conventions, for each core variable planned for adoption during the DIF project. | January 2008 (currents); April 2008 (temp, water level, salinity; begin ocean color planning) |
| Identify suite of standards such as data content model, metadata, etc., that will facilitate integration and interoperability of data across NOAA and ultimately, it is hoped, to the broader IOOS community. | February 2008 |
| Pilot Implementations of common data sharing infrastructure elements at data providers/ sources and end users. | Ongoing from February 2008 to April 2009 |
| Submission of DIF standards to DMAC standards process; Ongoing participation in process. | March 2008, ongoing |
| Define implementation level specifications that will inform the development, deployment, and operations of data sharing operations consistent with DIF principles; | August 2008 |
| Documented improvements or enhancements in access to, or use of, multiple, distributed (disparate) data sources for at least the 5 initial ocean variables; | January 2009 |
| Support and deploy software packages (reference implementations) for high priority interoperability tools for the | April 2009 |

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| DIF common data sharing infrastructure. | |
| Documented improvement in decision-support tool accuracy, resolution, or gained efficiencies in production or pre-production activities for each of the 4 decision-support tool areas; | July 2009 |
| Documented best practices and/or tools that support data integration, data management and data transport. | February 2010 |

## 1.4 Assumptions and Constraints

The following assumptions and constraints are fundamental underpinnings to the anticipated planning and execution of the DIF project. Changes to any of these factors could affect the cost, schedule, or scope of the work articulated in this plan.

**Table 2. Assumptions and Constraints**

| Assumption |
|---|
| There are sufficient staff and funding resources to carry out the planning and work tasks to implement integration of the 5 variables into 4 decision-support tools as defined in this plan; |
| Standards will be sufficiently defined and/or customized to enable integration of the 5 variables needed to achieve improvements in the 4 decision-support tools. |
| There is a value add to data integration for one or more decision-support tools that is measurable within the project lifecycle. |
| Funding for the DIF continues through month 36; expansion of the capabilities and functionality of the DIF product beyond this project period is contingent on favorable review of project results and available funding. |
| The 4 decision-support tools selected for this effort will be able to ingest or make use of the integrated data, after making appropriate adjustments, subject to needed and/ or available funding. |
| Modifications required to be made by legacy system owners to meet DIF functionality requirements will, to the extent possible, be minimized. |
| In so much that the DIF project will be compliant with Federal Enterprise Architecture and NOAA's GEO-IDE, the scope and definition of the DIF may be influenced as the requirements of these policies, as well as by those of GEOSS and U.S. IOOS DMAC, are developed. |
| At the end of the 36 month project period, assessment of the DIF project will determine the next steps towards the inclusion of additional variables, decision-support tools and of enhanced functionality. |
| Some non-NOAA sources of data will need to be integrated to demonstrate success of the DIF project. |
| Available NOAA networks and communication paths will be utilized to facilitate transfer and communication of data and information associated with elements of the DIF. |
| The NOAA IOOS Program shall ensure the DIF project elements meet the current security regulations, rules, and protocols required by NOAA and DOC. |
| Any current NOAA system that is identified as a participant to interface with the DIF project will continue its current level/ mechanisms of systems performance, but will establish necessary services or |

| |
|---|
| functions to provide data or information needed to achieve DIF objectives and to allow the NOAA IOOS Program to monitor and analyze the DIF system performance, health, and safety. |
| DIF success requires the cooperation and in kind support of data providers and decision-support tool developers and operators from NOAA Line Offices and Programs. |
| Approval of the candidate standards for the DIF identified by the Data Standards WG and endorsed by the Integrated Products Team will be made by the DIF Project Manager, with input from the Project Review Team. |
| DIF standards approved by the Project Manager will be submitted to the DMAC and DMIT standards processes. |
| **Constraint** |
| Initial funding and staffing available for the first year is much less than estimated and sufficient out-year funding is not guaranteed. |
| System engineering support was not yet in place at project initiation so traditional planning phases are out of sequence relative to the initial milestones that were defined at project inception. |
| Open source security concerns, in particular CIO regulations regarding OPeNDAP and related implementations, may limit options for integration. |
| Commercial off-the-shelf (COTS) software security issues may limit options for integration. |
| Key expertise needed for the project is currently staffed with volunteers from other NOAA Programs and Offices who have other full-time duties. |
| There is a possibility that existing standards will not fully address all of the requirements for the DIF project. To meet the needs of the DIF, work may be needed to adopt or adapt some existing standards, or when necessary (as a last resort), develop new standards. |
| Having documented standards is no guarantee for adoption or execution by the community. Program resources are often tight, and independent program processes already in place are often sufficient to achieve their individual objectives. Therefore, implementation assistance, guidance, and possibly training with appropriate budget dollars and defined milestones will be needed to encourage and facilitate application of the identified DIF standards. |
| The level of integration that can be achieved will be constrained by the capabilities and flexibility of existing (legacy) systems. |
| Successful data integration will depend upon data providers' assistance in merging and creating appropriate metadata and other data management functions and services (e.g. data content, transport, quality). |
| To achieve a high level of product quality based on time and resources available to execute, the DIF project has selected a set of priorities areas of data management it will address first. As such, the DIF project may not address all elements of data management such as data discovery, on-line browse and archive, and all aspects of metadata management. |

## 1.5 Success and Completion Criteria

At the end of 36 months, information will exist that will allow the NOAA IOOS Program Office to evaluate the success of achieving the project objectives including the premise that improved data integration and data management and dissemination of mission critical ocean related data increases the value and effectiveness of the data available for use in decision-support tools. Additionally an evaluation of major milestones achieved and an analysis of alternatives that could include such options as continuation and expansion of the project and associated products beyond the scope of the original effort or discontinuation of future integration efforts that build upon the DIF product will be conducted.

The following represent anticipated success measures for the project. These may be refined as the project proceeds:

- Establishment of a defined list of community-based data standards for data content, data transport, metadata, and data quality control that govern the DIF architecture, and are broadly applicable to a range of data types and parameters;
- Development of a methodology for data integration that is built upon this series of community-based standards that results in a **common data sharing infrastructure** that when applied advances data consistency and facilitates interoperability between independent data sources, and has the flexibility to be extensible to include additional functionality;
- Application of the DIF common data sharing infrastructure and data management services and functions to multiple data sources that demonstrates measured improvement in interoperability of the data;
- Demonstrated improvement to overall productivity of customer programs and specifically to their decision-support tools that implement use of the integrated data from the DIF such as:
    - more timely forecasts,
    - improved decision-support tool accuracy,
    - greater geographic coverage and resolution,
    - improved efficiency in time and other resources spent in tool execution (e.g. reduced development time, reduced time from data acquisition to product dissemination), and
    - reduced operating costs.
- Broader application of individual NOAA and non-NOAA data sources in the decision-support tools beyond what was used prior to the implementation of the DIF functionality, due to enhanced access to, and consistent formats of, previously “unavailable” (e.g. difficult to use/ access) streams of relevant data.
- Publication of a set of technical and non-technical documents that provide the defined DIF standards and architecture, lessons learned, best practices, and reference implementations to facilitate interoperability of the 5 IOOS variable data and to inform NOAA and National decisions on next-steps to integrate disparate sources of ocean observing data from multiple federal and non-federal IOOS partners.

# 2 Project Management Structure

## 2.1 Project Management Organization

Management structure of the DIF project is depicted in Figure 1. The DIF project is the responsibility of and is managed by the Deputy Director, NOAA IOOS Program Office, under the oversight of the Director, NOAA IOOS Program Office. Widely accepted project management techniques and systems engineering concepts will be used by the DIF Project Manager to plan, manage and track progress of the overall DIF effort. The DIF Project Plan and more detailed Project Management Plan are the guiding documents used by the DIF Project Manager. Within the NOAA Line Office structure, the NOAA IOOS Program Office is located in the National Ocean Service (NOS) and within the NOAA Goal Team Structure (not depicted in Figure 1) it is located in the Modeling and Observing System Infrastructure Sub-Goal within the Mission Support Goal.

In addition to the NOAA IOOS Program Office staff and supporting contractors, the key project planning and implementation entities are two project teams - the Integrated Products Team (IPT) and the Project Review Team (PRT). Task-oriented working groups within the IPT are chartered when necessary to address specific elements of the DIF development and deployment. The IPT and working groups provide the technical expertise and in kind support to plan, design, build, test and evaluate the DIF. The efforts of the IPT will be augmented by resources provided by the NOAA IOOS Program Office, as the budget allows. The PRT provides management oversight and guidance to the DIF Project Manager throughout the project duration. Where necessary, some project tasks will be executed by contract resources that will be directed by the IPT, the working group(s), or NOAA IOOS Program Office staff. These contract resources include system engineering support from the National Weather Service Systems Engineering Center (NWS SEC) and others as appropriate.

NOAA councils such as the NOAA Ocean Council and NOAA Observing System Council, along with the Chief Information Office Council, will be kept informed of project status through formal briefings, as well as other informal opportunities. It is expected that they will provide advice and counsel to the NOAA IOOS Program Director and NOAA IOOS Program Deputy/ DIF Project Manager. Other entities that have an interest in the DIF project include the Interagency Working Group on Ocean Observations, Ocean.US, the National Federation of Regional Associations (NFRA), as well as other ocean community forums. NOAA IOOS Program management and staff will leverage every opportunity to share project updates and discuss connections with related activities with these groups. Some examples of specific venues are noted in section 2.1.3 External Interfaces and Communications. A summary of information contained in this section is found in the DIF Project Charter (Appendix 1).

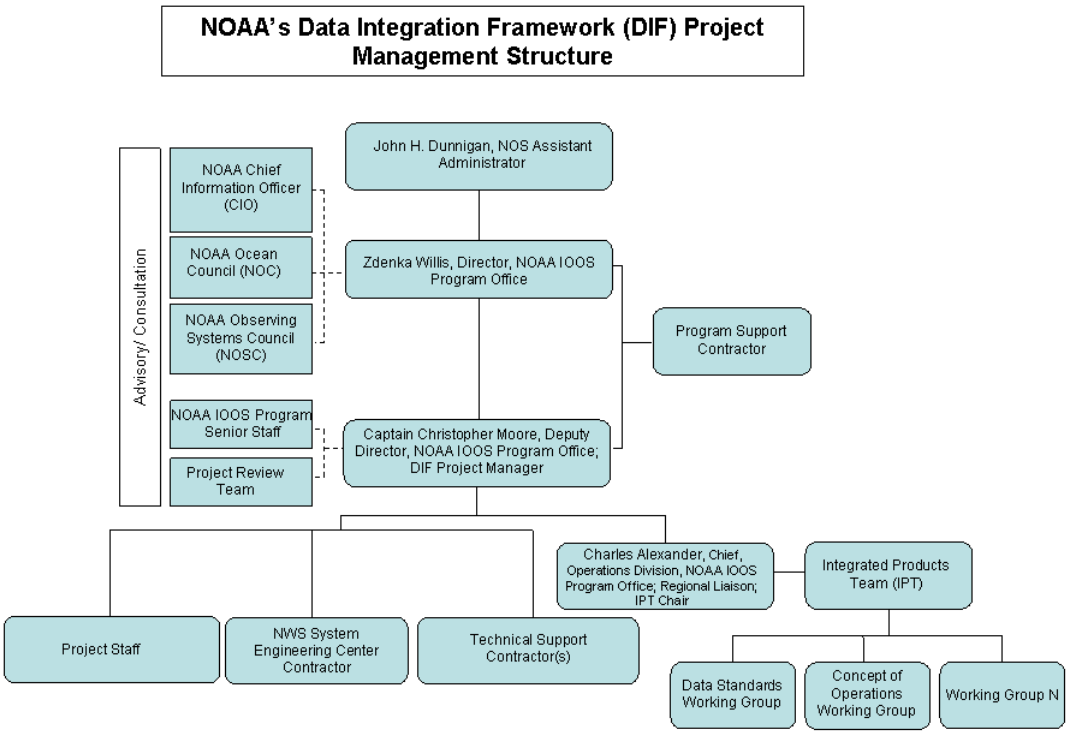


**Figure 1. DIF Project Management Diagram**

### 2.1.1 Roles and Responsibilities of DIF Project Participants

Roles and responsibilities of DIF project participants are found in Table 3 below:

**Table 3. DIF Project Roles and Responsibilities**

| Role | Responsibility |
|---|---|
| NOS Assistant Administrator | Provides high-level strategic oversight, direction, guidance, and advocacy support, internally and externally, for NOAA IOOS Program |
| Director, NOAA IOOS Program Office | Provides ongoing strategic review and support for DIF project; communicates status to and input from NOS AA and NOAA Councils as appropriate. Approves membership of the PRT. |
| Deputy Director, NOAA IOOS Program Office | Serves as DIF Project Manager; provides direction and leadership for the DIF project. Approves and/or modifies membership of IPT and working groups as appropriate. Leads the Project Review Team (PRT). Provides funding for IPT and IPT working groups subject to NOAA IOOS Program Office budget constraints. Defines DIF project goals, plans, and objectives. Manages progress towards project goals |
| Chief, Operations Division /Regional Association (RA) Liaison, NOAA IOOS Program Office | Forms, leads and chairs the Integrated Products Team (IPT). Forms or dissolves working groups as necessary to accomplish project tasks. Keeps DIF Project Manager informed about DIF progress through plans, technical documents or other outputs. Provides coordination and communication of DIF status to the National Federation of Regional Associations and Regional Associations. |
| NOAA IOOS Program Office Senior staff | Contributes strategic and policy inputs to the DIF Project Manager and chair of the IPT. Communicates DIF plans to NOAA IOOS Program Office constituencies. |

| Role | Responsibility |
|---|---|
| DIF Project Review Team (PRT) | Provides critical review, inputs and recommendations from a policy, strategic, and organizational view to the DIF Project Manager at key decision points during the DIF project life cycle. Composed of Line Office or Goal Team senior level personnel from the NOAA IOOS Program, relevant councils, offices and data management groups within NOAA who are knowledgeable in policy and budget matters and related data management projects, or who are responsible for data management and/or data processing areas of expertise. |
| DIF Integrated Products Team (IPT) | Provides overall expertise and inputs for all key DIF documentation, planning and implementation steps. Through the working groups that are composed primarily of IPT members and supporting contractor support, executes the work of planning, building, testing and evaluating the DIF. Composed of line office or Goal Team personnel associated with the four decision-support tools, representatives of data sources of the five core IOOS variables, data management experts, and advisors with specialized knowledge of key aspects of data integration/management and other relevant subject matter. Reviews Working Group plans and outputs, other DIF project outputs and provide inputs and concurrence as appropriate. Members may serve on one or more working groups. |
| IPT Working Groups | Technical experts who determine and execute deliverables or set of tasks as defined by working group plans, DIF Project Plan or Project Management Plan. Typically composed of IPT members but may include non-IPT expertise; typically chaired by an IPT member. Responsible for the more technical aspects of developing project documentation, technical documentation, software code or other DIF project outputs, i.e., building the DIF. |
| DIF Project Staff | Provides technical expertise and administrative support to the full DIF project process. Serves as the communications team that coordinates DIF project elements and provides guidance and support for the underlying infrastructure of the DIF project. Supports the DIF Project Manager, the IPT, PRT and Working Groups with preparation of materials, briefings and various administrative details. Includes the IOOS project staff, NWS SEC contractor and associated Contracting Officers Technical Representative (COTR), and technical support contractors. |

| Role | Responsibility |
|---|---|
| NWS Systems Engineering Center Contract Support | Provides systems engineering support to the DIF Project Manager, DIF Project Staff, IPT and working groups. Includes the Contracting Officer's Technical Representative from the NWS SEC. |
| Program Support Contractor | Provides overall NOAA IOOS Program Office management support to the DIF Project Manager and to the NOAA IOOS Program Director |
| Technical Support Contractor | Provides programming, IT, and technical support to the DIF Project Staff , PRT and IPT as needed |
| NOAA Councils | Provide NOAA governance and policy inputs, recommendations and advice to the DIF Project Manager and Director, NOAA IOOS Program Office, as appropriate. |

### 2.1.2 Operational Processes

The DIF Project Plan guides the overall efforts of all project participants. A Project Management Plan will be created by the DIF Project Manager to identify the key project milestones, the more detailed implementation steps and tasks associated with these milestones, and designated responsibilities. The DIF Project Manager will also utilize the IPT working group work plans and technical documents to update the DIF Project Management Plan and to provide inputs into the NOAA IOOS Program Office budget and planning processes.

The IPT is formed and chaired by the Chief, Operations Division, NOAA IOOS Program Office, under the direction of the DIF Project Manager. Working Groups and associated chairpersons are formed from the IPT by the IPT Chair with inputs from the IPT to address specific project tasks or groups of tasks. Usually these tasks have a specific start and end date so working groups will form and dissolve throughout the life of the DIF project. Typically the working groups, NOAA IOOS Project Office staff or DIF project supporting contractors will generate plans, technical documents, software code or other outputs to present to the IPT for review, evaluation and ultimately, concurrence. Once approved by the IPT, project outputs are provided to the DIF Project Manager who will brief the PRT at appropriate DIF major milestones. The PRT will provide guidance and inputs to the DIF Project Manager from a policy or management perspective. When appropriate, the DIF Project Manager and/or Director, NOAA IOOS Program Office, will provide DIF progress briefings to NOAA management, councils and other interested parties. IPT, PRT and working group membership are subject to change as conditions dictate or otherwise determined by the DIF Project Manager.

Due to their critical contributions to the DIF project, specific processes required for the IPT and PRT are described below.

#### IPT Operational Process

The IPT chair will convene a minimum of one standing conference call every third Thursday per month to review critical project documentation and plans developed by the IPT, IPT working groups and/or DIF project staff and contractors. Two to three times a year, and additionally as needed, the IPT chair will organize an IPT meeting at a NOAA or other convenient site. The IPT chair will coordinate and

synchronize all IPT and working group activities, and will keep the DIF Project Manager apprised of DIF progress. IPT members are expected to critically review materials and solicit other reviewers as necessary to provide comments and inputs representative of their organizations.

The IPT Working Groups are formed by the IPT Chair, usually from the members of the IPT. For specific tasks, the working groups may also include members that are not necessarily on the IPT, as recommended by IPT members. IPT Working Groups will be assembled to address specific technical issues or challenges and/or develop the technical information and material needed to identify a path forward for the DIF, per the request of the IPT and/or DIF Project Manager. In addition, working group members are responsible for completing the tasks required to build, test and evaluate the DIF. Meeting of the working groups occurs by conference call or in person as resources allow, typically several times a month or more as determined by each working group chair.

Working Group chairs, appointed by the IPT Chair, are responsible for the following activities:

- Establish and lead their working group,
- Schedule meetings and conference calls
- Guide the use of a web-based collaboration tool (WebEx) to facilitate group discussion and document sharing between calls and meetings,
- Prepare and modify (as needed) work plans for the working group that include milestones, tasks, resource needs,
- Facilitate and monitor progress of the working group tasks to maintain the schedule,
- Coordinate as appropriate with other working groups,
- Report progress to the overall IPT and other DIF working groups as appropriate,
- Provide regular updates to the IPT Chair and supporting NOAA IOOS Program staff,
- Report any issues and concerns with the task, resources or other items to the IPT chair

Under the leadership of a working group chair, each work group will develop a work plan that includes a list of subtasks, milestones, responsible individuals, level of effort and additional resources required to execute the plan. Typically individual tasks will also have a Statement of Work (SOW) and deliverables prepared by a working group member. Working group plans will be presented to the IPT to solicit input and recommendations and will be modified accordingly by the working group chair. Final plans will be briefed to the DIF Project Manager for concurrence and resourcing. Once approved by the DIF Project Manager, the task work plans become part of the Project Management Plan and will be used in NOAA IOOS Program Office budget and implementation plans. The DIF Project Manager will use the task work plans and associated documentation such as SOW's to track progress and determine accountability.

### PRT Operational Process

At the request of the DIF Project Manager and typically at key project milestones, the PRT will meet as necessary to be briefed by the IPT. Briefing materials will be prepared and distributed by the IPT Chair in advance of PRT meetings. PRT members are expected to review the materials and come prepared to discuss any concerns and questions during the meeting. PRT members will provide recommendations, advice and counsel to the DIF Project Manager based on their areas of expertise and background, focusing on NOAA corporate views, policies, and procedures.

### 2.1.3 External Interfaces and Communications

The DIF project impacts concepts and ideas about data integration, interoperability, and data management that are of relevance to other Federal and non-federal IOOS partners. Such entities include, but are not limited to, Ocean.US (DMAC), the Interagency Working Group on Ocean Observations (IWGOO), the Ocean Observatories Initiative (OOI) Cyberinfrastructure efforts, and IOOS Regional Associations and their coordinating body the National Federation of Regional Associations (NFRA). The DIF project is also relevant to the data management activities and plans of overarching earth observation programs such as the Integrated Earth Observation System (IEOS), the Nation's contribution to the Global Earth Observing System of Systems (GEOSS), of which IOOS is the U.S. ocean contribution. Through communication with the GEOSS representative(s) in NOAA, the DIF project will inform those associated with the planning for those overarching efforts. Communication of the DIF project to our external partners includes both formal and non-formal interfaces such as:

- Contribution to the Ocean.US DMAC Standards Process through the submission of standards identified for use in the DIF, or through participation on DMAC Steering or Expert Teams;
- Regular communications to Regional Association through:
    - Reporting on status of the DIF on monthly Regional Association conference calls;
    - Efforts of the NOAA IOOS Program Office staff that have responsibility for the oversight and coordination of technical, and non-technical, communications to and from the regions;
    - Annual Federal Funding Opportunity proposal criteria that incorporate guidelines based on DIF requirements and/ or project findings;
    - Participation in annual NFRA meetings;
    - Dedicated trips to meet with Regional Association staff;
- Routine status reports by the NOAA representative at IWGOO monthly meetings;
- Participation at OOI – Cyberinfrastructure workshops;
- Other Ocean.US or RA-sponsored meetings;
- Posting of relevant information on the NOAA IOOS Program Website;
- Communication by IPT members to relevant groups of which they are members (e.g. Quality Assurance of Real-Time Ocean Data (QARTOD), Marine Metadata Initiative, etc.;
- Informal interactions of opportunity by NOAA IOOS Program Office Staff, and the NOS Assistant Administrator, with colleagues in other federal and non-federal agencies.

Communication of DIF efforts to the International community occur through participation in International Oceanographic Data and Information Exchange (IODE) workshops, through the collaborative international partnerships that exist with open ocean observing system partners in NOAA's Office of Climate Observations, or through coordination with the NOAA GEOSS manager and/or participation on GEOSS committees or working groups.

# 3 Project Engineering and Development

## 3.1 Overall System Engineering Approach

The DIF project focus in on developing a common data sharing infrastructure to facilitate the integration of data that use the five core ocean variables from a yet to be determined number of NOAA and non-NOAA data sources, and to provide improved utility of and access to that data. Additionally, to assess the value of the newly integrated data, the performance impacts of this data on the functionality of four specific NOAA decision-support tools ("customers") will be measured as part of the project. To meet these goals, the DIF project will, through a phased approach which allows for continual evaluation of evolving capabilities and products, implement a series of pilot projects at selected data sources and providers which will result in the ability to more readily integrate, access, and use data from those providers. In addition, client-side pilot projects will be implemented, as needed, to adapt the four customer tools to be able to access and use the newly integrated data in their decision-support tools so that performance improvements can be measured.

While the scope of the DIF encompasses 5 variables, 4 customers, and a number of data sources and providers, to effectively accomplish this complete scope there is a need to achieve intermediate levels of progress from which to review lessons learned, refine implementation procedures and/ or methods based on these lessons, and ultimately promote sustainable development of the project. Because of this, the pilot activities will be implemented in phases. For example, the initial phase might result in the implementation of a pilot project(s) involving 1 variable, 1 customer and 2 data providers. Subsequent phases will sequentially add variables for integration, customer tools, and data providers in successive phases until the entire suite of 5 variables are being served from N sources in an integrated fashion and have been tested in the 4 customer tools. This phased approach will help mitigate technical and programmatic risk, and as noted will provide lessons-learned to be applied to each subsequent phase.

The systems engineering approach that will be used to achieve this phased process is an iterative, or spiral, approach which employs highly structured systems engineering practices, while allowing rapid prototyping and risk-analysis to be performed at juncture points of the project. As noted in the national DMAC Plan[1] for IOOS: "In the Spiral Model, selected requirements are chosen for development to an operational level. Then, more requirements are added, and the development process is repeated through this 'spiral' until all requirements are accomplished. The phases can be executed using a waterfall-like process (i.e., with requirements specification [or updates], analysis and design, system development, and verification performed for each phase). Each phase (sometimes referred to as an effectivity), would then represent a complete end-to-end execution of a subset of the requirements."

Application of this approach will result in an initial DIF functionality within a relatively short timeframe. The design and development activities of each successive phase will build on the previous to ensure an integrated system and to minimize the likelihood of building stovepipe systems in each phase. Lessons learned in early phases will contribute to refined functional requirements and designs for subsequent phases, thereby improving the performance of the pilot implementations after each iteration. Additionally,

[1] Data Management and Communication Plan for Research and Operational Integrated Ocean Observing Systems, Part I Overview, March 2005, Page 51.

because skill and efficiency should be gained with each phase's execution, each successive iteration should proceed with greater rapidity than the previous.

Major technical outcomes, or deliverables, are defined in Table 1 (DIF Major Deliverables) of Project Plan section 1.4. Greater detail and specificity on milestones and deliverables can be found in the work breakdown structure in section 4 of the Plan and in the DIF Project Management Plan.

The major systems engineering tasks, and the approach for applying these to the DIF pilot implementations, are described in detail below. The process is streamlined by performing many functions in parallel. While this adds some technical risk due to starting the design before the requirements are finalized, initiating development before the design is completed, etc, it is critical to achieve the planned technical outcomes in the required timeframe. These tasks will be conducted for each phase; the initial phase/ spiral will establish a baseline that can be built on in subsequent phases.

It is important to note that the DIF project will not require changes to operational systems at the data sources/ providers. Similarly, the integrated data will not necessarily be used in operational customer decision-support tools/ models. Rather, augmented by support of the NOAA IOOS Program when necessary, customers' may execute ingestion of the integrated data in test or experimental products modified from the operational to incorporate the new functionality.

The diagram below illustrates the system engineering approach:

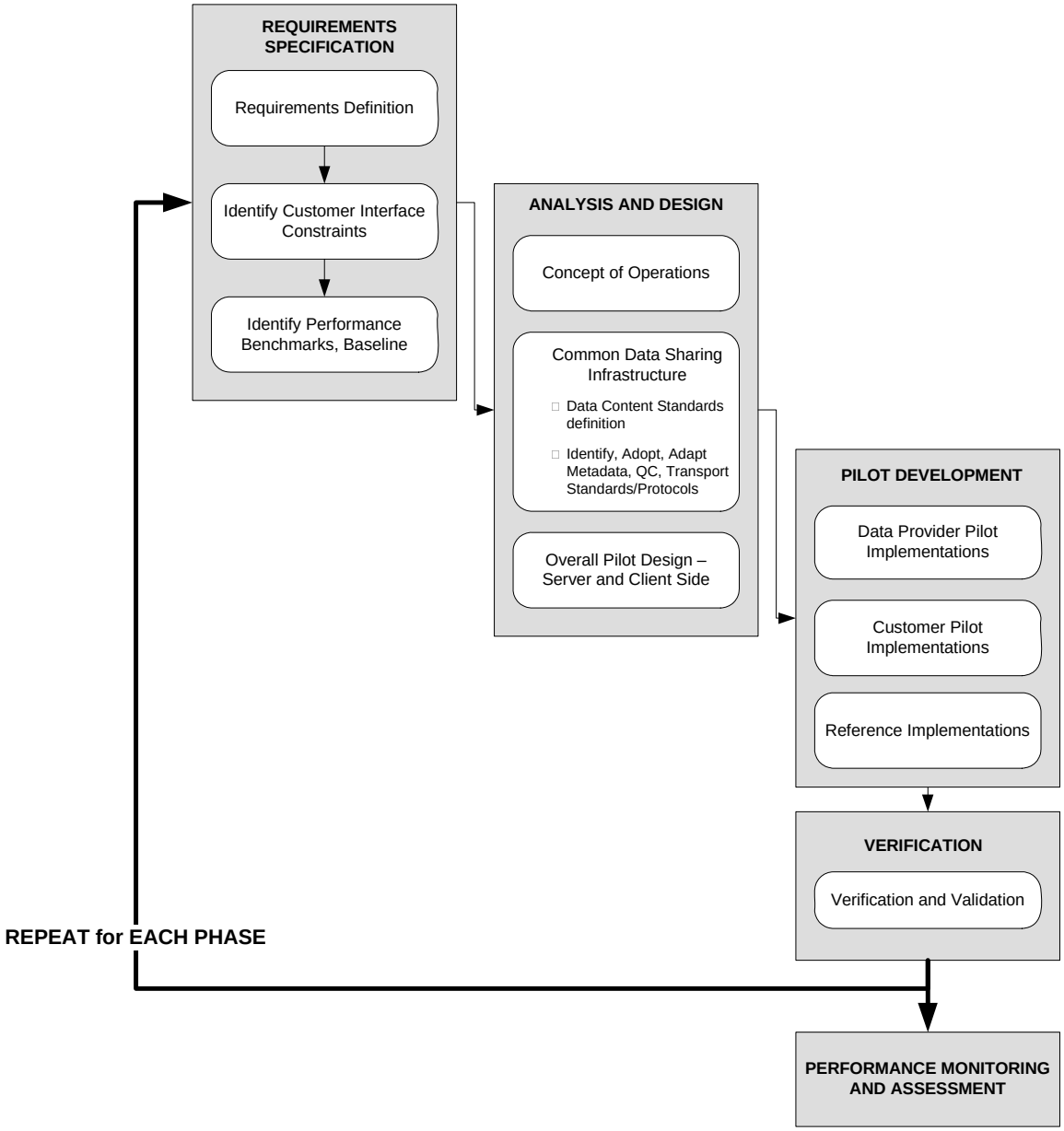


**Figure 2. System Engineering Approach**

### 3.1.1 Requirements Specification

**OVERALL OUTCOME:** Documented functional requirements for the DIF, an understanding of interface constraints of the customer models, and performance benchmarks for the customer models.

1. **Requirements Definition** – The DIF project requirements will be collected, analyzed, and documented. All requirements proposed or envisioned by the key stakeholders will be captured; priority will be given to those requirements that are within the project scope and

those that the IPT feels are reasonable to implement in the available timeframe and resources. Non-priority requirements will be reserved for later phases or deemed out-of-scope of the DIF. Because requirements definition is the typical starting point for a project, there are no dependencies other than access to the knowledge sources and key stakeholders for requirements collections. As necessary, requirements will be refined as the project progresses through each phase based on lessons learned and other inputs that shed light on the need to modify certain requirements, or include new ones. The sources for the DIF requirements include:

a. Customers: Operators/ developers of decision-support tools

b. The DIF IPT

c. Owners/ managers of data sources

d. NOAA IOOS Program

**Outcome:** Functional Requirements Document.

2. **Identify Customer Interface Constraints** – Each customer (decision-support tool) that is to receive integrated data from the DIF will be examined to determine the level of constraint that exists related to the ability to receive/ ingest the integrated data into their decision-support tool. The DIF project may need to initiate client-side pilot implementations that will adapt the customer decision-support tools' ingest mechanism so that it supports the DIF common data sharing infrastructure (e.g. data content and transport standards). This task will identify the customer interface constraints so that such client-side implementations can be designed.

   **Outcome:** Documented constraints for each customer decision-support tool.

3. **Identify Performance Benchmarks, Baseline** – Performance benchmarks will be identified for each customer decision-support tool. Methods will be developed for objectively measuring these benchmarks to provide baseline performance assessments. Existing performance measures and methods will be used wherever possible, augmented as needed to ensure DIF performance can be adequately assessed. Baseline assessments will be performed for each customer decision-support tool. The methods developed for baseline performance assessment will later be used to measure the DIF performance, during the Performance Monitoring and Assessment task.

   **Outcome:** Performance benchmarks for each customer. Tools, processes, and methods for performance assessment. Baseline assessments against which to compare DIF performance.

### 3.1.2 Design Phase

**OVERALL OUTCOME:** Design document describing functionality of the DIF, standards and protocols to be implemented, and the overall design for implementation of pilots at the data provider/ source locations and customer interfaces.

1. **Concept of Operations (CONOPS)/Use Cases** – Based on the functional requirements document, a set of "use cases" or operational scenarios will be identified. Each use case will define a specific operational scenario associated with the DIF (a function or operation that it must support), will identify the inputs to the system and their sources for each use case, will

define what processing is required at the various stages, and the outputs (and formats) desired from the various stages of processing. These use cases will be used to collapse similar operations used in the various system stages into defined subsystems so a consolidated architecture of functions and responsibility is evolved from the use cases. The inputs to, output from, and processing supported by each subsystem can then be summarized, from which functional requirements associated with each subsystem can be assigned. A matrix of functional/ operational requirements, along with a mapping of these requirements to proposed subsystems will be developed.

**Outcome:** A CONOPS document containing the agreed upon use cases for the system, each pictorially represented for the ease of understanding, each identifying involved proposed subsystems, and the expected information flows.

2. **Common Data Sharing Infrastructure –** The requirements definition process will identify the initial data sets for integration. Also based on information on data needs specified in the requirements, a conceptual data model will be developed that includes the definition of data content standards and the identification, adoption, and/ or adaptation of standards and protocols for quality control (QC), transport, and metadata for the five core variables and appropriate data types.

    a. **Data Content Standards definition** – Data dictionaries with dependent vocabularies and domains and the conventions for each of the major data elements such as location, date/time, units, data types, and the core variables will be defined. Data content standards will be defined to ensure compatibility of data from disparate sources. The data content standards will, to the extent possible, make use of any commonly accepted conventions, with customization as needed for the DIF application/ service. The data content standards will evolve over time as other data sets from additional sources are integrated. Any agreed upon standards will be submitted to the National DMAC standards process.

    **Outcome:** Data Content Standards defined.

    b. **Identify, Adopt, Adapt Metadata, QC and Transport Standards and Protocols** – Standards for metadata and data quality control will be identified and evaluated with respect to their applicability to the DIF requirements, data sources, and evolving data sharing infrastructure. At a minimum, profiles, grids, time series, and moving sensor data types will be supported. Optimal transport protocols will also be identified. Standards will, to the extent possible, make use of any commonly accepted conventions, with customization as needed for the DIF application/ service. Once standards and protocols are selected, the team will agree on any customization needed or further specification that may be required to ensure interoperability between data providers. Any agreed upon standards will be submitted to the National DMAC standards process.

    **Outcome:** Metadata and Quality Control Standards and Transport protocols selected, with definition of additional specifications needed for use when implementing DIF pilot projects.

3. **Overall DIF Design** – The overall DIF design will encompass the outcomes of all design activities described above, and will define the overall guidance for the pilot implementations including identification of the roles and responsibilities of data providers, preferred service interface practices, and a set of systems specifications that inform the development, deployment, and operation of data sharing operations.

   **Outcome:** Overall DIF Design document.

### 3.1.3 Development Phase

**OUTCOME:** Completed DIF pilot implementations at data providers and sources and customer locations as well as for reference implementations.

1. **Data Provider Pilot Implementations** – These build capacity at data provider and source sites to adopt and operate the DIF functions. This effort involves the implementation of data management practices identified in DIF specifications and best practices. Subtasks in this area include software and database engineering, systems and network administration, metadata development and documentation of quality practices.

2. **Customer Pilot Implementations** – These build capacity in the identified decision-support tool programs that utilize the integrated data. This effort involves implementation of capability in the identified four customer tools to allow them to utilize the newly integrated data from the data provider pilots. Subtasks in this area include software engineering to ingest new and modified data sources.

3. **Reference Implementation Pilots** – The purpose of this pilot area is to identify and support several high potential data management system configurations that have cross-cutting utility among DIF participants and to ensure that these tools are stable and made available for utilization by new data providers and customers in the DIF community.

### 3.1.4 Verification

**Outcome:** Test and validation of data sharing between data providers and customers.

Following completion of development, data provider and customer pilot implementations will be tested to verify that the data management practices adhere to the specifications, that all functional requirements are met, and that the customer decision-support tools can make use of the data. Code modification, "bug" fixes, etc. will be addressed during this stage until the components are deemed to meet the requirements.

### 3.1.5 Performance Monitoring and Assessment

Although the DIF project is considered a risk-reduction proof-of-concept system that is not necessarily intended to itself become an operational system, the system will need to be sustained for an extended period to support performance monitoring and assessment. Following validation, the performance assessment methods will be applied to the customer decision-support tools to objectively measure

performance impacts compared with the baseline. It is anticipated that this performance monitoring and assessment will be ongoing for up to 24 months to ensure accurate and up-to-date assessments. Results from this assessment will guide the development of an analysis of alternatives that will be used to inform NOAA management, and the national IOOS community in deciding the next steps to be taken beyond the three year DIF period.

# 4 Project Planning and Resources

## 4.1 Resources

The DIF Project will require dedicated DIF project management and staff contributions, in-kind support from IPT, IPT working group and PRT members, as well as additional funding resources. Categories of needed resources include design, development and testing, planning and coordination, operations and maintenance, and performance monitoring. These categories include specific funding for IPT personnel as required, technical and engineering support contracts, travel to meetings or conferences, support for or participation in standards groups or activities, supplies (computers, software, etc), and funding for the DIF data providers and sources and customers of the decision support tools to modify/ add software code, or software tools. Support for training workshops is also anticipated. All funding is contingent on budget availability. Required funding estimates will be modified as work plans are refined and the project evolves and progresses.

An estimate of required resources is available through FY08, described below, and will be better refined as the project progresses and iterations or phases occur. Out year funding will be estimated as initial planning, development and implementation steps are completed. If required funding is not available or is delayed from the need date, the DIF project milestones will be modified, de-scoped or deleted. Estimated FY08 resource needs are:

- In kind resources such as contributing to meeting discussions, material preparation, review of materials, generating specifications or guidelines, modifying code or software routines is estimated to be 25-75% for the IPT and/ or IPT working group members, depending on the tasks.
- PRT contributions are estimated to take between 5-10% of each member's time.
- Engineering contractor support is estimated to be 392K.
- Design, development and testing costs are estimated to be 1.5M, non-recurring.
- Planning, operations, and maintenance and performance monitoring is estimated to be 575K, recurring for the three year project period.
- DIF staff, technical support contractors and management contributions consist of 80-100% staff time.

## 4.2 Tracking and Control

Tracking and assessing the progress of the DIF project is the responsibility of the DIF Project Manager, based on inputs received from the IPT/IPT Chair, PRT meetings, and progress reports and briefings that reflect progress against milestones and achievement of performance measures. In particular, the DIF Project Manager will refer to the DIF Project Management Plan to guide project tracking and control. Meetings with the PRT and NOAA councils and advisory groups such as the NOAA Observing System Council (NOSC) and the Office of the NOAA Chief Information Officer (CIO) may also provide guidance.

The DIF Project Management Plan sets time schedules and delivery deadlines as well as identifies the responsible individual or team for each of the milestones derived from the IPT working group work plans

and the system engineering documentation. It represents the scope of work and sequence of delivery for the major DIF planning, development and implementation tasks. A summary of major milestones and responsible parties can be found in the Work Breakdown Structure in the next section.

The DIF Project Manager will also utilize the IPT work plans to guide the allocation of required funding. For any funds that are disbursed, the DIF Project Manager will request a more detailed statement of work (SOW) from the recipient of those funds that describes how the funds will be expended in terms of the task, milestones, and costs associated with each task, what the deliverable(s) will be, and who is responsible for execution of each task. Progress reports from the recipients of funds, tied to the tasks and milestones defined in the SOW, will be provided to the DIF Project Manager in the form of a written document and briefed to the IPT/IPT working groups through established meetings. The written reports will also be posted on the NOAA IOOS DIF WebEx communication site.

## 4.3 Work Breakdown Structure

The work breakdown structure below highlights only the major milestones associated with the DIF project. For definition on specific tasks and task responsibility under each milestone, please see the DIF Project Management Plan. Note that under "Active Groups", each entity will not necessarily address each element noted in the milestone description, but each group noted has a role within the milestone task process.

**Table 4. DIF Project Work Breakdown Structure**

| WBS # | Milestone Name | Description | Active Groups |
|---|---|---|---|
| 1 | **Program Management and Support** | | |
| | Management | Project oversight and tracking, coordination, and reporting, resource allocation, contract and acquisition management | DIF Project Manager and Operations Manager |
| | Support | Technical and administrative support to project managers and teams | DIF project staff, Technical support contractors |
| 2 | **Project Planning and Tracking** | Development of DIF project plan, continual review and update of project plan | DIF project staff, DIF Project Manager; IPT/ PRT |
| 3 | **Technical Work and Engineering** | | |
| 3.1 | **Requirements** | Includes development of critical project support documentation including Requirements definition, As-Is baseline data management capabilities for data sources, identification of customer interface constraints for new DIF functionality, and development of performance measures and | NWS SEC, IPT and IPT working group(s) |

| WBS # | Milestone Name | Description | Active Groups |
|---|---|---|---|
| | | benchmarks to measure value of DIF integration. | |
| 3.2 | **Standards** | Identification of candidate data management standards from universe of existing standards, or as a last resort development of new ones, for various elements of DIF functionality; See System Design milestone for more; Submission of standards selected for the DIF to the National DMAC and NOAA DMIT standards processes. | IPT working group(s), IPT, DIF project staff, NWS SEC |
| 3.3 | **System Design** | Development of the DIF concept of operations (CONOPS); Development of DIF conceptual and physical design; Documentation of the common data sharing infrastructure design including the adoption, adaptation of identified standards for data content, metadata, transport, and quality control; Selection of data sources to be included in the DIF | IPT working group(s), IPT, DIF project staff, NWS SEC |
| 3.4 | **Development Tasks** | Approved standards for data content, transport, metadata, and quality control will be implemented at selected data providers and sources; establish interfaces with customers; implement reference implementations. | IPT working group(s), IPT |
| 3.5 | **Integration, Test, Deployment** | Verify functionality of each element of the common data sharing infrastructure (data content, transport, metadata, quality control) at each of the data providers and sources where implemented and assess level of data compatibility between sources; interface the newly available transformed/ integrated data to the decision-support tools | IPT working group(s), IPT |
| 3.6 | **Performance Monitoring and Assessment** | Using the performance measures and benchmarks, assess performance of the DIF; determine the value of DIF integrated data to the decision-support tools. | IPT working group(s), IPT, DIF project staff, NWS SEC |
| 4 | **Management Reviews and Decision Points** | Review of system deployment and performance at various intervals and/ or decision points during the project including initial, mid-point of project, and end of 36 month period. | DIF Project Manager and NOAA IOOS Program Director |
| 5 | **Analysis of alternatives** | Describe possible alternatives for maintaining/ expanding the DIF, identify a recommended alternative, describe system development life cycle for the recommended alternative, provide a development and implementation plan for the selected alternative. | NWS SEC, IPT/ IPT working group(s), PRT, DIF Project Manager, NOAA IOOS Program Director |

## 4.4 Risk Assessment and Mitigation

**Table 5. Technical Risks and Mitigation**

| RISK DESCRIPTION | LEVEL OF RISK | MITIGATION FACTORS |
|---|---|---|
| Streamlined approach requires some design and development activities to be done in parallel. This development approach can result in a system that does not meet all requirements. | M | Communication among the IPT members and working groups must be frequent and open so that changes in design and implementation of pilots are communicated to developers and formally tracked. |
| Iterative approach could result in stovepipe solutions for each pass through the process. | M | Design documents will be analyzed to ensure their extensibility to additional data sources, data sets, and customers. |
| Standards used in the DIF project may not achieve recommended status from either the National DMAC or NOAA DMIT standards processes. | M | Keep DIF stakeholders engaged in standards development; keep NOAA and IOOS stakeholders informed of DIF project standards development activities; involve NOAA and IOOS stakeholders in interoperability testing. |
| Potential inability of a given NOAA entity within the development process to be flexible and to respond to and adapt rapidly during the iterative process, particularly to the extent that it affects the data provider side of the equation. | M | All participating NOAA "entities" will be well informed of and engaged in the design of the DIF development plans such that said entities should be able to respond and adapt as readily as possible. The NOAA IOOS program will provide necessary personnel and financial resources, the latter contingent on budget availability, to support and facilitate an "entity's" ability to implement the DIF plans. |

**Table 6. Budget Risks and Mitigation Factors**

| RISK DESCRIPTION | LEVEL OF RISK | MITIGATION FACTORS |
|---|---|---|
| Costs exceed resources available | H | Project and associated expectations are re-scoped to match available resources; milestones are postponed or delayed. |
| Budget resources are not available | M | Options are explored including |

| | | |
|---|---|---|
| when needed to meet the milestone schedule. | | accelerating other tasks, combining tasks, or assigning tasks to those who have available resources. |

**Table 7. Schedule Risks and Mitigation Factors**

| RISK DESCRIPTION | LEVEL OF RISK | MITIGATION FACTORS |
|---|---|---|
| Milestones are delayed. | M | Milestones are revised to accommodate delays and the schedule is extended. |
| Milestones are not met | M | Deliverables are re-scoped; some capabilities are minimized or deleted. |

# 5 Project Status

## 5.1 Status

### 5.1.1 As-Is Documentation

The purpose of the *DIF As-Is Baseline Systems Document* is to summarize the current "as-is" state of several systems or capabilities that provide access to one or more of the five core ocean variables used by the four customer decision support tools. The intent is to provide baseline documentation of the subject systems and data products including data sources, formats, contents, frequency, metadata, and transport and access methods currently in place. This document will serve as both a general reference and as a basis for the further development of the DIF requirements and concept of operations.

The scope of this document is primarily the outputs of, and the methods of access to, the various collection and processing systems that provide the data products in use by the customer decision support tools. It includes summary descriptions of each system as well as more detailed information tables for each data product in use, including responsible Line Office, data product format, source data attributes, metadata information, product dissemination, Information Technology security, and data integrity and archival properties. In addition, a brief description is given of the data products and users, metadata policy, transport and access methods, data archiving, and quality control mechanisms. Following each summary are tables that list more details about each data product being used by the identified customer decision support tools.

Interviews with system owners/operators, the CASANOSA database and other existing documents were used to compile these documents.

### 5.1.2 Interoperability Tests

In May and June of 2007, a series of "Interoperability Tests" were conducted for selected sources of each of the Data Integration Framework's (DIF) five core variables. The primary purpose was to establish a baseline understanding of the current status of data availability and access across NOAA and the level of interoperability between disparate sources. However, some non-NOAA sources were also tested for completeness. Test results will be used to guide the design and development of the DIF. The goals of these tests were to:

- Provide a snapshot of the "As Is" condition as related to data structure, transport, and compatibility of the data from selected NOAA programs and offices and several non-NOAA sources;
- Assess the current state of interoperability of data from distributed sources within NOAA and several non-NOAA sources;
- Document consistency in the application of standards and protocols used across NOAA programs and offices and non-NOAA sources for selected elements of data management and communication (DMAC) and to identify gaps in this usage;
- Demonstrate the readiness of the data for 'integration'.

Each of the five tests was conducted by a NOAA program or office familiar with the use and/ or distribution of data (Salinity and temperature: CSC; Ocean Color: NCDDC; Currents: NDBC; and Water

Level: CO-OPS). In each test, data were pulled from a variety of independent and distributed NOAA data providers. In some tests, pulls were also done from several non-NOAA sources. OPeNDAP and web services that implement OGC were the intended primary focus of the tests, although other transport protocols were also included in the vision. Due to a security breach disabling NOAA's OPeNDAP 3 and 4 servers, alternative mechanisms (i.e. non-OPeNDAP transport protocols) to obtain data were used. The DIF project team has since worked with the NOAA CIO's office to obtain permission to access several NOAA OPeNDAP sites to enable future tests to be conducted that include these OPeNDAP sources. The tests themselves were rapid, taking a maximum of 4 days of staff effort for 1-2 individuals, including preparing the results reports.

In the reports, testers provided detailed technical process results as well as their general findings about the condition and compatibility of the various data sources (Note that these observations have not been validated by the providers).

Some general findings common to the tests included:

- Data are sufficiently interoperable within a given data provider/ source, however compatibility is not extensible between sources, precluding direct integration (e.g. different data vocabularies and structures in use).
- There is a general lack of documentation provided by data providers on the standards and protocols being used (e.g. transport, vocabularies/ taxonomic conventions, data dictionaries)
- The degree of data compatibility can be seen in something as simple as the expression of time or place. For example, there is not a common standard vocabulary across providers to express time stamps or latitude/ longitude as nearly every provider used a different standard.
- Integration of data is further hampered by an absence of metadata provided with the data. If metadata are available they are often not located in association with the data themselves and are difficult to find.

### 5.1.3 Customer Meetings

To be successful, the DIF needs to be designed and built so that it will effectively address the data needs of NOAA's data users. As noted earlier in this document, the DIF project goal is to develop and implement a methodology to integrate data such that will improve the functioning (e.g. efficiency, resolution, accuracy) of four NOAA decision-support tools ('customers'). Because the teams developing and operating these decision-support tools are the experts at knowing what they need, a series of customer meetings with individuals who are 'experts' in each of the four decision support tools were conducted in order to define the requirements focused on the sources of the five core variable (e.g. format, transport and access, timeliness, metadata and pedigree, access to additional sources not currently readily available, etc.) for the DIF.

An initial round of meetings was held in January and February, 2007 and a second series conducted in July 2007. Based on meeting results, as well as lists of functional requirements for each customer derived from their input, the maximum overlap between their needs has been identified. The insight that has been gained from these meetings will enable the DIF to be designed and implemented to respond directly to the requirements of the users.

As the development of the DIF progresses, the input and feedback from these customers will continue through their representation on the IPT and PRT.

### 5.1.4 Early Planning Efforts

A kick-off meeting for the DIF was held in Silver Spring, MD on April 3-4. An initial "design" team was formed with participants from Southwest Fisheries Science Center (SWFSC), National Data Buoy Center (NDBC), Coastal Services Center (CSC), Pacific Marine Environmental Laboratory (PMEL) and National Geophysical Data Center (NGDC). The goal of the initial meeting was to select a list of systems to integrate into the DIF, discuss needed standards, and to gain the design team members' perspective on a preliminary DIF design. Meeting notes were prepared and distributed.

Two conference calls followed the kick-off meeting to maintain engagement and to continue momentum on a path forward. On July 24 and 25, 2007, the group met with members of the NOAA Data Management Integration Team in Boulder, CO to continue these discussions and further develop the DIF concept. Meeting notes were prepared and distributed to all participants. System engineering expertise was also obtained through the NWS Systems Engineering Center.

On October 18, 2007, the original DIF design team became members of the larger Integrated Products Team (IPT). Three working groups of the IPT were also commissioned: data standards, concept of operations, and functional requirements to focus NOAA expertise on specific technical tasks necessary to design, develop and implement the DIF.