NOAA's Enduring Functions

NOAA's enduring functions are the things that the agency does, and will continue to do, irrespective of Line Offices or Goal Teams. The NOAA Functional Model, depicted in the figure below, is an account of NOAA's enduring functions and how they relate to each other (and to external functions) to create value for the nation. Each function is a link within a value-chain; it adds value to inputs to create better outputs. The Model shows that, at a general level, NOAA manages its resources to produce its core content and to provide final products. Stakeholders then apply NOAA's products, as well as NOAA's directed resources. Many of NOAA's products also feedback to add value to the production of new NOAA content.

The Model provides a conceptual account of what NOAA does, as derived from statutory mission drivers. It provides a perspective of the work of the agency that transcends disciplinary boundaries, organizational boundaries, people, places, and scale of activity. How NOAA performs these functions over time may change, but – barring a significant change in NOAA's mission – the functions themselves will not. As its name implies, the purpose of the Functional Model is to depict only the *functions* in which NOAA engages. Only after these functions are accounted for can NOAA begin to address where and how the functions should be done. The Model is thus a crucial first step toward informed, purposeful "oneNOAA" integration.

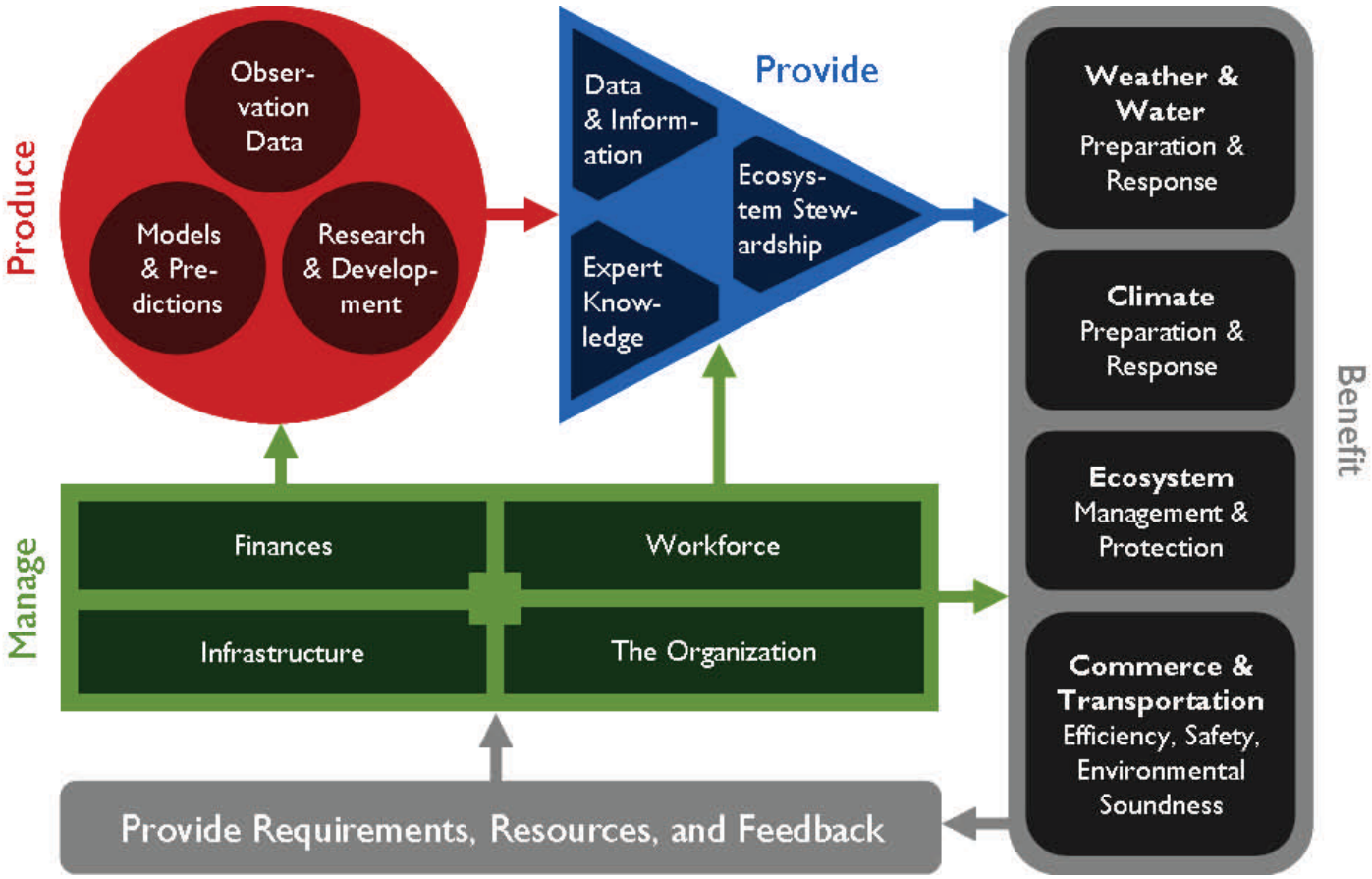

Figure 1: The NOAA Functional Model. Shapes represent functions. Arrows represent the flow of value-added. Red, green, and blue functions are internal to NOAA. Grey functions are external to NOAA.

NOAA's traditional organizational structure is divided by its lines of business, called Line Offices. Line Offices provide the agency's authoritative and budgetary hierarchy: who is charge of what, and who pays for what. Under the administration of Vice Admiral Lautenbacher, and in response to the findings of the Vice Admiral's Program Review Team and his implementation of PPBES, NOAA began to understand its operations within a structure of discrete programs that satisfy strategic goals.

The NOAA Functional Model is another way of understanding the agency's operations, this time by agency functions as they reside within a value chain. The functions are defined in terms of their inputs and outputs. The Model is intended to be specific enough to capture any particular NOAA activity, but also general enough to encompass all that a given Line Office or Goal Teams does. The Model is particularly useful in the planning phase to understand the consequences to the rest of the supply chain of adding, removing, or integrating capabilities.

The functional categories of the Model have been distilled from the set of legislative requirements drivers identified by all of NOAA's forty-five Programs. They represent NOAA's enduring functions: the NOAA that *is* rather than the NOAA that could or should be. These categories were developed by a PPI-led working group including representatives from each NOAA Line Office and Goal Team. The Model has been accepted by the NOAA Executive Council as an accurate depiction of the work of the agency.

Utility of the Functional Model

The Model has three desired outcomes. First, it is a necessary foundation for the broader goal of a NOAA-wide Concept of Operations (CONOPS) to specify how NOAA produces and provides particular products. The genesis of the Model is in FY 2008 Fiscal and Programming Guidance, which stated that PPI "will develop a high-level model that describes NOAA's enduring functions, how those functions interrelate, and how they could be affected by changing external conditions. This model will enable more detailed function/structure analyses and assessments of alternative CONOPS." With a CONOPS, agency management at any level can identify best practices, apply lessons-learned, find common ground for collaboration, and ultimately improve the efficacy and efficiency with which NOAA conducts its mission.

Second, for the next iteration of the NOAA Strategic Plan, the Model will account for the work of the organization, its inputs and outputs, in order to match evolving capabilities with evolving needs – irrespective of preexisting organizational structure. An effective strategic plan for an organization as complex as NOAA must be founded upon a thorough understanding of all of its functions, how they interrelate, how they add value, and how they perform in meeting their requirements.

Third, for improved communication throughout PPBES, the Model provides a common analytical framework and lexicon for both the NOAA workforce and policy-oriented stakeholders. It will improve the quality and consistency of information exchanged between Programs, Goal Teams, PPI, PA&E and the CFO, and it will illustrate how NOAA creates value for society, the environment, and the economy for DoC, OMB and members of Congress. In so doing, it will empower each of these parties to communicate precisely what they need and expect from the others. For instance, it allows for an explicit conversation about whether an information service bottleneck could be overcome by improving functions to observe, model, or publish and distribute final information products.

A common analytical framework and lexicon means that the Model can also provide a foundation for a NOAA-wide enterprise architecture. Enterprise architecture is a tool for managers of an enterprise such as NOAA to integrate all of the information necessary to sustain the operations of the enterprise. It includes the requirements, capabilities, and performance measures of the agency as a whole, as well as those of its most particular elements. The structure of enterprise architecture is all of the interrelationships between the information types, which will necessarily parallel the structure of the functions and sub-functions of the enterprise. For this reason, a model of NOAA's functions is a basis upon which to develop a NOAA-wide enterprise architecture.

Explanations of the Functional Categories

The Model bins NOAA's functions into three internal functional categories (***manage***, ***produce***, ***provide***) and one category for external application (***apply***). The external application functions are the major "market niches" that NOAA orients itself toward. Within each category are a collection of functions that are defined by their outputs. This means that the Functional Model is effectively also a model of outputs. The arrows in the model represent the value-added from each sort of output. Table 1 below provides a descriptive account of each functional category, and mirrors the shape of the Functional Model as depicted in Figure 1. Figure 3 (page 8) illustrates these functional categories adding layers of value at each step toward ultimate benefits.

Produce functions represent NOAA's core capabilities, where NOAA has an unmistakable comparative advantage over other organizations. The agency observes the environment and gathers environmental data, it models the environment and makes environmental predictions and projections, and it conducts research and development for greater understanding of the environment in order to improve all of the other functions. The value-added of *produce* functions is to create intermediary goods out of the resources provided by the *manage* functions. These intermediary goods are, in turn, the building blocks of the final products of the *provide* functions. *Produce* functions yield the scientific or technical content of a final product, whereas *provide* functions yield its ultimate form and mode of delivery.

Provide functions are those functions where NOAA provides products for the direct consumption by partners or end-users. For example, issuing a weather forecast, warning, or advisory – as well as determining the exact form that these will take – are *provide* functions; they are all functionally distinct from the modeling and predicting that enable them. Similarly, NOAA's provision of expert knowledge and ecosystem stewardship are directly consumed by our partners and end-users. They are also supported by the intermediary goods that are the outputs of the *produce* functions and the resource allocations that are the outputs of the *manage* functions. The value-added of provide functions are the final, application-oriented products that NOAA customers need to conduct their everyday business.

Apply functions are those that NOAA's customers conduct, not those of NOAA itself. They are broken up by Mission Goal because this is the way NOAA understands external application areas from a strategic perspective. Those who perform apply functions are partners and end-users in government, industry, academia and the public at large. Coastal zone managers at the state level, for example, apply NOAA information and NOAA directed funds to conduct their operations. Private weather information vendors apply NOAA data, NOAA-developed models, and NOAA-trained expertise to conduct their business. Universities use NOAA grant money and NOAA data sets for their research. The value-added of *apply* functions is the ultimate social and economic benefit to society.

Manage functions are similar to capital management functions of any organization. All organizations manage capital as embodied in financial assets, physical infrastructure, workforce abilities, and the structure, norms, and business processes of the organization itself. The value-added of *manage* functions results from the appropriate distribution of different forms of capital to the other functions. *Manage* functions support each other, as well as the *produce* and *provide* functions. NOAA capital is also managed to support the external *apply* functions of our partners.

Following the application of NOAA products is the element of the Model that completes the cycle. Stakeholders assess the performance of NOAA's products in meeting their intended requirements Adjustments to requirements and resources is fed back into NOAA through its *manage* functions, determining the amount of types of requirements and amounts of capital that are provided to NOAA in the next budgetary cycle.

Table 1: Categories of NOAA Functions. Reflecting the composition of the Functional Model in Figure 1,

Explanations & Examples of NOAA Functions

This section provides a description of each NOAA function and a few concrete examples, which are intended to be illustrative rather than comprehensive. Many of the examples are derived from the OMB Business Reference Model, while others are more NOAA-specific. Explanations and examples of *apply* functions are not given here, but should be thought of as the NOAA-dependent activities of our partners and customers, grouped along the lines of NOAA's four strategic goals. Here we deal with the functions of each category in sequence: *manage*, *produce*, then *provide*.

Manage Finances. This function includes the major activities of budgeting and accounting. Available funds are assessed, as are the costs and benefits of potential expenditures. Final spending is decided according to organizational priorities. Inflows and outflows of financial capital are categorized and tracked. It includes:

- Budget Formulation and Execution
- Capital Planning
- Federal Asset Sales
- Accounting
- Grants, Payments, and Loans
- Collections and Receivables
- Asset and Liability Management
- Reporting and Information

Manage Infrastructure. Similar to every other organization, NOAA manages the facilities that provide the workspace and tools for every other function. In NOAA's case, this includes facilities such as offices, laboratories, and weather stations; observation platforms such as ships, aircraft, satellites, and buoy networks; and IT systems from supercomputers to personal computers and office networks. Managing this infrastructure involves procurement, operation, maintenance, modernization, and replacement. It includes:

- Facilities, Fleet and Equipment Management
- Construction
- Security Management
- System Development
- Lifecycle/Change Management
- System Maintenance
- IT Infrastructure Maintenance
- Record Retention
- Information Management
- Information Infrastructure Management

Manage Workforce. Managing the workforce is about enabling the skilled workers of a highly scientific and technical organization such as NOAA. It includes managing people – employees, contractors, and NOAA Corps – but goes further to include optimizing people's access to and sharing of the data, information and knowledge that they need to be productive, and at the levels of quality that they need it. The activities involved are hiring, contracting, training, and intra-agency communication. Managing workforce includes:

- Workforce Planning
- Staff Acquisition
- Employee Development and Performance Management
- Organization and Position Management
- Compensation Management
- Benefits Management
- Employee and Labor Relations

Manage The Organization. Like every federal agency, NOAA must manage itself as an organization to optimize performance. This includes managing NOAA's own internal processes, such as PPBES, Matrix Management, Regional Collaboration, enterprise architecture, supply chain management, performance evaluation, and general administrative support. It also includes managing its own business, relations with other organizations through legal and regulatory mechanisms, as well as communicating and collaborating with stakeholders. Managing the organization includes:

- Legal Prosecution, Litigation, and Defense
- Foreign Affairs
- Program Monitoring and Evaluation
- Legislation Tracking
- Congressional Liaison Operations
- Policy and Guidance Development
- Enterprise Architecture
- Strategic Planning
- Product Outreach and Public Relations
- Acquisitions

Produce Environmental Observations Data. The foundation of all of NOAA's work is accurate, reliable observation data of the environment, which can be obtained in situ or remotely, with platforms on land, sea, in the air, or in space. Producing environmental observations data includes acquiring and validating environmental observations data from external (non-NOAA) sources. It includes acquiring and directly observing the human components of the environment, such as the production and consumption data for natural resources and other social and economic data. It also includes the technology transfer and deployment capabilities necessary to transition highly developed observations equipment from the experimental phase (within either NOAA's in-house R&D or a partner's external R&D) to the operational phase. Providing environmental observations data includes:

- Operating Observations Platforms
- Recording Data with Instruments
- Telemetry with Platform
- Data Transmit / Receive
- Processing Observations Data for Use
- Controlling Data Quality
- Assimilating Observations Data
- Archiving Observations Data

Produce Environmental Research and Analytic Tools. In order for NOAA to continually advance its operational services, it must conduct applied research of the ocean and the atmosphere, as well as the development, demonstration, and deployment of new technologies. NOAA must also have the ability to transfer the results of more basic R&D from other institutions into the agency's own portfolio of capabilities. Providing environmental research and analytical tools includes:

- Documenting Entities, Properties & Processes
- Posing Answerable Questions & Testable Hypotheses
- Articulating Relationships & Causal Mechanisms
- Engaging Knowledge Networks
- Defining Goals for Sensor, Model or other Analytic System
- Identifying and Choosing Technological Capabilities
- Designing Systems to Tailor Technological Capabilities to Defined Goals
- Building, Testing and Refining Prototype Systems

Produce Environmental Models and Predictions. Models codify our understanding of the world. NOAA develops, employs, and maintains models to describe dynamic meteorological, hydrological, climatological, and ecological processes. Modeling requires observations data and foundational modeling research as inputs in order to produce predictions and projections as outputs. Providing environmental models and predictions includes:

- Defining Modeling Problem and Constraints
- Codifying Necessary Parameters and Quantitative Relationships Between Them
- Assembling New and Existing Components into Complete Models
- Transitioning Research Models or Employ Useful Components Where Possible
- Calibrating Model with a Test Data Set
- Running Model against Independent Existent Data and Validating Outputs
- Developing Efficient Data Acquisition Schemes
- Developing Operational Data Flow
- Simulating Future Environmental Conditions
- Making Predictions Based on Simulations
- Verifying Predictions on Different Temporal & Spatial Scales
- Augmenting Model Based on User Feedback
- Employing Successful Methods from Research Models
- Upgrading Hardware
- Coupling with Other Models

Provide Data & Information. This is likely the most well known of NOAA's functions, from the perspective of the external community. NOAA provides both the data and the assessments and analyses of those data vital to informing partners and customers about the current and future environmental conditions. Data and information include simple matters-of-fact about the environment as derived from observations and models, such as the number of salmon estimated within a given area, or the predicted surface temperature 24 hours ahead. Data and information always exist within a format (electronic or otherwise) that is distinct from the content. Data and information products always exist (and create value) as a combination of both form and content. Providing data and information includes:

- Website Design, Construction, Maintenance
- Public Archive and Database Maintenance
- Cartography and GIS Development
- Analytical Composition and Information Design
- Publishing, Editing of Public Documents
- Graphical User Interface Development
- Translations and Numeric Conversions
- Issuing Forecasts, Predictions, Projections
- Issuing Warnings and Advisories
- Issuing Assessments of Environmental Conditions
- Development of Information Format Standards
- Broadcast of NOAA Radio
- Developing Interoperable Communication Systems with Partners
- Customer Services and Help Desk Services

Provide Environmental Knowledge and Expertise. In addition to providing data and information, NOAA also provides a less tangible, but no less important product: knowledge of the environment, and of techniques for environmental monitoring, forecasting, and management. NOAA's "know-how" is distinct from its data and information. As with Data and Information, Knowledge and Expertise cannot exist independent of form. NOAA provides knowledge to the public via outputs such as professional journal articles, conference presentations, technical reference manuals, official testimonies, participation in inter-agency and international decision processes, websites and blogs, as well as media consultations. Providing knowledge and expertise includes:

- Presenting Scientific & Technical Findings
- Publishing Peer Reviewed Articles
- Publishing Technical Manuals
- Attending Conferences & Workshops
- Training on NOAA Products
- Educational Services
- Consulting on Scientific and Technical Issues
- Decision Support on How to Apply NOAA Products to Particular External Applications
- Technical Advice on Methodologies for Observations, Analysis, Modeling, Forecasting, and Coastal and Marine Resource Management
- International Advice & Leadership
- Advice & Leadership to Federal, International State, Local & Tribal Governments
- Congressional and Courtroom Testimony
- Media Services

Provide Stewardship of Coastal and Marine Ecosystems. In addition to supplying the data, information, knowledge and expertise to partners so that they can manage the ecosystems within their domain, NOAA itself has responsibilities to manage national trust resources. These activities range from regulation, to protection, to recovery. Providing stewardship of coastal and marine resources includes:

- Protection of Geographic Areas
- Protection of Sanctuaries
- Protection of Critical Habitats
- Protection of Research Reserves (Wetlands)
- Protection of Threatened or Endangered Species
- Regulation of Fisheries
- Conducting Stock Assessments
- Issuing Permits
- Enforcement of Laws
- Recovery of Habitat
- Hazmat Response

NOAA within its Organizational Context

An understanding of NOAA by its functions must be consistent with the understanding of NOAA as an organization in relation to other organizations. Figure 2 below is a context diagram. It depicts NOAA as a "black box," defined only in terms of its inputs and outputs, from and to NOAA's partners.

Inputs take the form of different kinds of capital: financial, infrastructural, intellectual (people and ideas), and organizational (processes, structures, and norms). NOAA's management of these inputs is handled via its four manage functions (see page 4). Likewise, the outputs in Figure 2 correspond to those of NOAA's three provide functions (see page 6), namely: data & information, knowledge & expertise, and ecosystem stewardship.

NOAA exists in the context of its congressional budget line with NASA and NIST. It receives financial inputs from the public via Congress, OMB, and DoC. It provides outputs to and receives inputs from sister agencies in departments across the federal government, as well as academia, the private sector, domestic and international authorities. These other sectors have secondary relationships with the public, such as when NOAA data is used to provide a private weather forecast or when NOAA grant money assists in the education of the next generation of meteorologists.

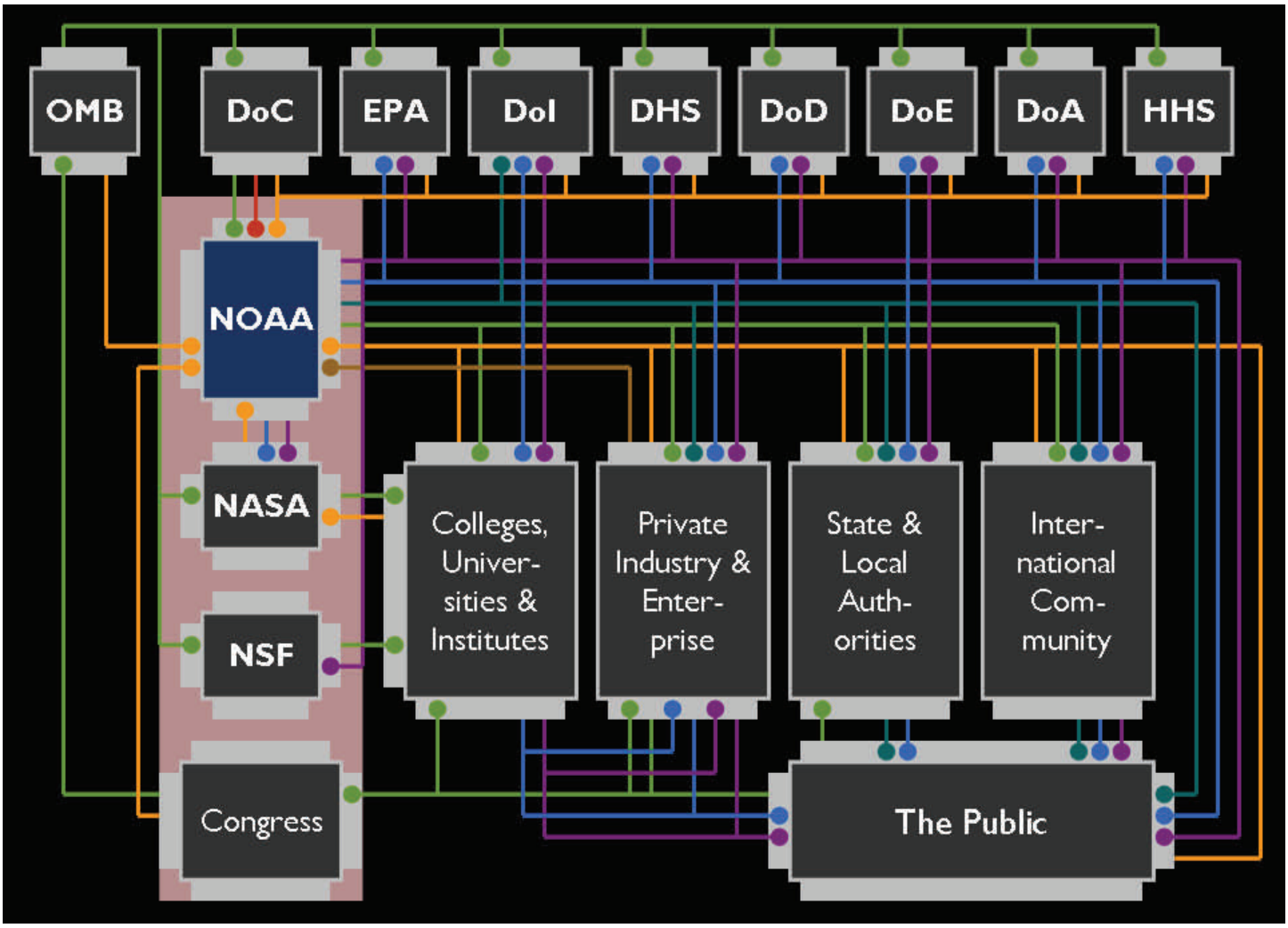

Figure 2: NOAA Context Diagram. NOAA's inputs are composed of financial capital (green), intellectual capital (yellow), infrastructural capital (brown) , and organizational capital (orange). NOAA's outputs are composed of financial capital (green), data & information (blue), knowledge & expertise (purple), and ecosystem stewardship (teal).

The Difference of a "Functional" Model

The Functional Model is different from other models of NOAA. The most important difference is that it is a model of functions, not a model of the people, places, or things that deploy those functions or are affected by them. Indeed, a single Program, single office, or even a single person could deploy many of these functions in a single day.

Thus, the Functional Model does not display NOAA's budget- and authority-based organization, which follows a traditional line and staff office model (and which has culminated from the separate evolution of distinct, historical bureaus). This traditional model answers the question, "Who is responsible for what?" Neither does the Functional Model display NOAA's vision- and mission-based organization, which follows a Goal and Program model. This model answers the question, "Why do we do what we do?" In contrast to both of these existing models, the Functional Model answers the more basic question, "What kinds of things do we do?"

The Functional Model shares the objectives of the NOAA "Business" Model. Both seek to connect the agency's resources to its activities, to its outputs, and ultimately to its stakeholders. The "Business" Model embodies a comprehensive list of elements that relate to NOAA strategy and roughly sketches out which elements are related to which other elements. The Functional Model is a focused, analytically rigorous tool for understanding how NOAA operates as a system. It answers the question "what does NOAA do?" by referring to the set of requirement drivers approved by NOAA General Council. It defines agency functions, categorizes those functions, and codifies the discrete value-added relationships between the functions.

The advantage of the Model is that it allows us to capitalize on the incorporation of "oneNOAA." Because the Model functions are idealized concepts of real-world activities, they enable us to see what is *similar* among the things we do – complementing our natural habit of focusing upon what is *different*. To be sure, attention to the unique characteristics and roles of all the elements of our agency is an important managerial perspective to hold, particularly in defense of threatened programs. But the perspective of commonality affords us maximum flexibility for the future. The Functional Model captures all existing activities, but could include more, different, or possibly fewer of them. It does not prescribe how these activities, extant or potential, are performed or who performs them.

Whatever we deem appropriate for the development of NOAA, any changes would have to be justified within the agency and then beyond: in the Department, at OMB, and in Congress. The higher up in the managerial or budgetary hierarchy one goes, the less people of authority are familiar with the details of real-world activities within NOAA and the more they can comprehend idealized forms. The public and their elected representatives are primarily concerned with "what kinds of things we do," secondarily with "why we do what we do," and finally with "who has control over what." The same is true, not inconsequentially, for any specialist within NOAA who requires an understanding of the other areas NOAA and how his or her activities relate to them.

It is important to note that the Functional Model, like any taxonomical system of classifying idealized forms, must be truthful to be useful; it must classify down to the level where one reaches real-world instances of those forms. The Model can be a powerful tool for facilitating communication and action, but we must take care to make it as honest a representation of NOAA functions as possible. The Model must therefore be continually developed to match NOAA's understanding of what it does.

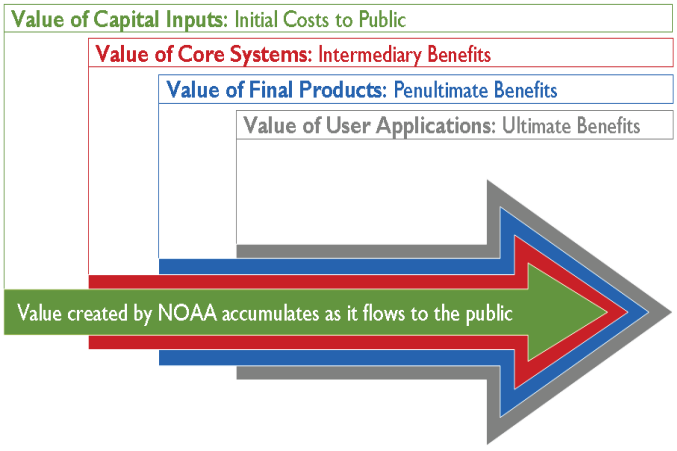

Figure 3: Functions Adding Value. Each function adds value to the outputs of previous functions in the value chain.