PUBLIC PROCUREMENT AND INNOVATION IN THE UNITED STATES

FINAL REPORT

Nicholas S. Vonortas
Center for International Science and Technology Policy
& Department of Economics
The George Washington University

With

Pushmeet Bhatia
Ph.D. Candidate
Public Policy Program
Trajtenberg School of Public Policy and Public Administration
The George Washington University

Deborah P. Mayer
MA Candidate
International Science and Technology Policy Program
Elliott School of International Affairs
The George Washington University
EXECUTIVE SUMMARY

The public sector in the United States purchases approximately half a trillion dollars’ worth of products and services annually. This very significant public expenditure could, in principle, be harnessed to assist in promoting innovation and the international competitiveness of the country.

Public procurement is carried out at two levels, the Federal level and the State level. While federal agencies like the Department of Defense and the Department of Energy account for the larger share, State governments have independent procedures set down for State level procurement.

The regulation binding on all federal agencies is the Federal Acquisition Regulation (FAR). FAR provides procedural rules only that control the procurement process. The two most important principles in FAR, considered an inherent part of all procurement decisions, are cost savings and competitive processes. Innovation, or priority for innovative products, is not promoted by FAR as an essential policy consideration.

Many federal agencies substitute FAR with similar rules that adapt FAR to their own specific needs (e.g., AIDAR for the Agency for International Development and HHSAR for the Department of Health and Human Services). In addition, the Office of Management and Budget issues from time to time circulars and memorandums with instructions to federal agencies regarding enhancing economy, effectiveness and efficiency in public procurement.

The substantive policies are mostly left to the discretion of each acquiring federal agency which is responsible for defining specifications and the evaluating criteria per procurement. Thus, while procurement in this country is subject to a mesh of regulations issued and administered by a wide range of agencies, there remains significant decision-making power to the procurement manager in each agency. For larger, more diffuse agencies this empowerment is frequently transferred down to the specific procuring bureau. The independence to each bureau to come up with its own procurement needs and execution is based on the overall federal practice of giving maximum discretion to the end client or the acquiring agency in laying down procurement rules fitting to the overall mission.

Most of the ‘strategic’ procurement in United States beyond defense/security is geared towards achieving a social purpose such as environmental protection, energy conservation, assisting disadvantaged groups in the population, and the like. Innovation may be the outcome of the quest for such results. Cost efficiency, a primary driver at least since public procurement reform in early 1990s, also occasionally results in innovation while trying to be flexible and cut costs.

State governments are not bound by FAR, Executive Orders and other federal regulating mechanisms. In practice, however, they learn extensively from federal practice and follow its principles extensively when laying down procurement rules for State agencies. Across States innovation has not been made an underlying requirement for procurement. Some States seem to place more emphasis on innovation as it is considered an important business revenue stream (like MD), but an overall direction towards innovation is still missing.

Procurement reform has become an important topic of public debate in the United States over the past couple of decades. Cost rationalization and minimization have surfaced as the most
powerful drivers of procurement reorganization. The rationale of cost minimization notwithstanding, investing in innovation is a costly and risky enterprise which may occasionally run counter to short-term finance criteria. Discouragement of innovation may also be reinforced by tightening financial management which adds administrative burdens possibly prohibiting the most innovative (read small) organizations to participate. Chief acquisition officers report tendencies to over specify procured product characteristics mainly out of fear of litigation of unfairness claims. This runs counter to innovation where one would want to specify the desired performance characteristics and leave product characteristics to be proposed by the supplier.

The second Part of this Report outlines a set of interviews with chief acquisition officers carried out by the research team. It also summarizes examples of innovative procurement by federal agencies.

Generally speaking, the interviews supported the main ideas in this report: while FAR and its adaptations provide procedural rules that have standardized procurement processes across agencies, the substantive policies are mostly left to the discretion of each acquiring agency (or even bureau within the agency) which is responsible for defining specifications and the evaluating criteria per procurement. Thus, as long as the principles of cost effectiveness/efficiency and competition fairness are met, innovation becomes the premise of the acquiring body. The extent of innovation achieved through public procurement, thus, varies a lot across government. Outside of the national defense/security area, innovation is not an end but a means towards achieving some social purpose such as environmental protection, energy conservation, assisting disadvantaged groups in the population, and so forth.

There is significant thinking and awareness among federal public procurement managements regarding the need to keep improving the procurement process and promote innovation. Infusions of managers from the private sector (and the defense contingent) to top public procurement management positions seem to promote and facilitate this process. The availability of well trained personnel was considered key.

Over the past 18 months, a transformation has begun. The current Administration has taken an interest in this area and has been pushing for changes. The White House Office of Federal Procurement Policy (OFPP) has created committees with large and small government agencies to discuss what they refer to as “innovative procurement practices.” The discussions are new and the teams have been meeting for less than a year. The common topics of interest on the table are leveraging the purchasing power of the federal government, creating a cloud computing system, training the incoming generation of acquisition officers, and learning from business to improve efficiency. Through the OFPP working groups, a community of procurement officers has formed. Many realize they are facing the same issues and that they are not taking full advantage of the flexibility FAR provides and the power that is at their fingertips. There will likely be a more strategic push in the near future from this group to change to procurement process more proactively to foster innovation.
# TABLE OF CONTENTS

**Executive Summary**

**Motivation**

## I. Source Review

### Introduction

#### A. Current Practices and Procedures

- **Summary**

  - **Federal Procurement**
    - 1) Federal Acquisition Regulation
    - 2) Executive Orders, OMB Circulars, and Memos
    - 3) Agency level acquisition guidance
      - a. Department of Energy
      - b. Department of Education
      - c. Department of Health and Human Services
      - d. Environmental Protection Agency
      - e. Department of Interior

  - **State Level Procurement**
    - 1) State of Maryland
    - 2) State of Virginia
    - 3) State of California
    - 4) State of Texas
    - 5) State of Florida

#### B. Sector Based Practices

- 1) Environment
- 2) Healthcare
- 3) Energy
- 4) Infrastructure

#### C. Small Business Innovation Research Program

#### D. Successes and Failures

- **Summary**
  - 1) The Integrated Disability Evaluation System
  - 2) Investment in Transportation Systems
  - 3) Proposed Improvements in application of R&D for Forestry Services
  - 4) Failure to commercialize space technologies
  - 5) Partnership Fund for program Integrity Innovation

#### E. Calls for Reform

- 1) Government Accountability Office Report
- 2) National Procurement Fraud Task Report
II. Cases

Summary Responses - Agency Interviews
1) Department of Energy
2) International Trade Commission
3) Department of Commerce
4) National Oceanic and Atmospheric Administration
5) Office of Federal Procurement Policy Workshop
6) Additional Comments from CAO Interviews

Instances of Innovative Public Procurement
1) Census Bureau: TIGER Program
2) Federal Aviation Administration: Automatic Dependent Surveillance-Broadcast Program
3) NASA: Constellation Space Suit System
4) Department of Energy: Creating on Offshore Wind Energy Industry in the United States
5) National Oceanic and Atmospheric Administration

References

Annex A Executive Orders, OMB Circulars, and Memos
Annex B List of Contacted Individuals for Interviews
Annex C Interview Invitation Letter
Annex D Interview Questionnaire
INNOVATION AND PUBLIC PROCUREMENT IN THE UNITED STATES

MOTIVATION

The public sector accounts for a significant part of economic activity in OECD member countries (Block and Lopez-Bassols, 2010). The average share of government expenditures in gross domestic product (GDP) is above 40 percent, varying from over 50 percent in Sweden and France to about 35 percent in Japan and the United States to around 20 percent in Mexico (OECD, 2009). Definitions of the appropriate role of the public sector also vary extensively but they include some form of providing public goods and services and responding to citizens’ and taxpayers’ needs. This includes general public administration, the provision of national security and safety, some forms of education and basic research, health and social care, and other functions. While, as implied above, the share of these services provided by the public sector varies extensively between countries, the socio-economic importance of the public sector is undoubtedly quite significant everywhere.

The performance of the public sector and its efficiency in providing public services has been a major concern in democratic societies since ancient times. The primary source of this traditional concern is the relative size of the public sector and the fact that it administers taxpayer funds. Pressures on the public sector for increased efficiency and productivity of resource use have mounted in recent years, however, due to rising costs, increasing awareness and demands from citizens and business, demographic changes, environmental degradation, and globalization pressures. Put simply, taxpayers expect “a higher bang for the buck”: the public sector must achieve more with less.

This naturally calls for innovation, both process and product/service innovation. As far as the public sector is concerned, process innovation means providing more (perhaps marginally improved) services at the same (or even lower) cost. Product innovation means providing new or significantly improved services and impacting through public expenditures for acquisition the ability of the rest of the economy to produce new and significantly improved products and services or to produce them more efficiently.

This study focuses on the latter type of innovation in one country (United States). More specifically, the study focuses on US public sector practices that procure innovation. It addresses practices that induce innovation either (a) by specifying levels of performance or functionality that are not achievable with off-the-shelf solutions or (b) by supporting research and development (R&D) for goods and services to be procured afterwards, thus sharing the risks of the R&D needed to develop innovative solutions.
**PART I: SOURCE REVIEW**

**INTRODUCTION**

Innovative public procurement is defined as “when a public agency acts to purchase, or place an order for, a product – service, good or system – that does not yet exist, but which could probably be developed within a reasonable period of time, based on additional or new innovative work by the organization(s) undertaking to produce, supply, and sell the product being purchased (Edquist, Hommen & Tsipouri, 2006). Further, public procurement has been said to promote innovation in many ways: by creation of new markets, creation of demand pull, and providing a testing ground for innovative products (Rothwell, 1983).

Innovative public procurement has been discussed worldwide to understand how governments can assist in development of new technologies and promote businesses, research and, by extension, the economy. Though this issue has received much attention in Europe, it is hard to find research papers on this matter in the US as well as US examples of public procurement that might have promoted innovation outside the national defense/security areas. Though the United States has a strategic orientation in their public procurement, it is not connected to innovation per se (Fraunhofer Report, 2005). *According to this study, most of the ‘strategic’ procurement in United States is geared towards achieving a social purpose like environmental protection, energy conservation, and assisting disadvantaged groups.*

Public procurement has been categorized in many different ways depending on what is being procured, for whom, and for what purpose. The first level of distinction is between general and strategic procurement. Any public procurement done to simply fulfill a need of the buying agency with off-the-shelf products refers to *general public procurement*. Procurement is considered ‘strategic’ when the demand for certain technologies, products or services is encouraged in order to stimulate a certain market (Fraunhofer Report, 2005, pp 15). Others further categorize forms of innovative public procurement on the basis of level of innovation being promoted. *Developmental procurement* refers to a procurement where technologies must be developed from nothing, whereas *adaptive procurement* refers to a procurement where some innovation is needed to customize the technology for the need in question but the basic technology is already out there (Edquist and Hommen, 2000, pp 21-22).

Another categorization of public procurement is based on the end user of the procurement. *Direct public procurement* refers to acquisitions where the end user of the procurement is the government itself. *Cooperative public procurement* is defined as when public agencies buy jointly with private purchasers and both utilize bought innovations. *Catalytic public procurement* is when a state agency initiates the procurement but the innovation is used exclusively by private user at the end (Edquist and Hommen, 2000, pp 22-23).
Further, three main roles have been defined for innovative public procurement (Fraunhofer Report, 2005, pp 18-19). Market creation occurs when a market for the technology being procured does not yet exist. Market escalation is achieved when an established market for the technology already exists but requires further development to succeed commercially. Market consolidation helps standardize criteria or technical specifications for the technology to be used in the public sector leading to similar developments in the private sector.

SECTION A

CURRENT PRACTICES AND PROCEDURES

SUMMARY

It is estimated that the public sector in the United States purchases approximately half a trillion dollars’ worth of products and services annually. This very significant public expenditure – the largest of its kind in the world – could, in principle, be better harnessed to promote innovation and the international competitiveness of the country.

Public procurement is carried out at two levels, the Federal level and the State level. Though the bigger share of procurement is done by federal agencies like the Department of Defense and the Department of Energy, State governments have independent procedures set down for state level procurement.

The regulation binding on all federal agencies is the Federal Acquisition Regulation (FAR). However, FAR provides procedural rules only that control the procurement process. Many federal agencies substitute FAR with similar rules that adapt FAR to their own specific needs (AIDAR for US Agency for International Development, and HHSAR for Health and Human Services Department). Besides FAR, the other important controlling documents are the Office of Management and Budget (OMB) Circulars and Memorandums issued from time to time as instructions to federal agencies with the aim of promoting economy, effectiveness and efficiency.

_The substantive policies are mostly left to the discretion of each acquiring federal agency which is responsible for defining specifications and the evaluating criteria per procurement. Procurement in the United States is subject to a mesh of regulations issued and administered by a wide range of agencies and still leaving significant decision-making power to the procurement manager in each agency._¹

¹ The absence of a regulation as in the EU legislations on public procurement (Directive 2004/18/EC and Directive 2004/17/EC) is apparent. No regulation or established procedure in the US provides guidance on innovative public procurement.
Figure 1 sketches out the control structure of government procurement in this country.

**FEDERAL PROCUREMENT**

Federal Procurement is administered at three levels. The FAR is generally considered the ‘Bible’ of federal procurement and is binding authority for all federal agencies. The Executive Orders and OMB Circulars and Memos have similar authority as FAR. Issued by the White House, these documents consist of procedural details along with policy considerations fueling the change/instructions. The third level of administration takes place at the agency level. Each federal agency has an in-house Acquisition Office that puts in place policies and procedures for that Agency under the purview of FAR.

I. **Federal Acquisition Regulation (FAR) and the General Service Administration**

FAR lays down the procedures and general policies to be followed during federal procurement. The Federal Acquisition Circulars are used by the General Services Administration (GSA) to issue clarifications of changes in FAR from time to time. The portions of FAR relevant to our discussion are given below.

**FAR 9.202** states the process of qualifying a vendor for federal procurement but it does not lay down the aspects that should be considered while selecting a vendor. Discretion is given to the individual agency to decide what they think should be a qualifying condition for a vendor. *This clause reflects the powers given to each agency in deciding what is considered worth procuring and from whom.*
FAR 11.002 further lays down the policy to be followed while defining the needs of the agency. It provides that full and open competition be the underlying practice. Further it provides that restrictions on the item specifications should be placed in very special circumstances where such restrictions are essential to achieve agency needs. This clause, thus, shows a similar trend of letting the agency decide what is important for them. An interesting observation is made in Subpart 11.002 (2) where the agencies are actually required to define their needs in a way so that they can be met through ‘commercial’ or ‘non-developmental’ items. This clause might be perceived as discouraging innovation instead of promoting it.

However, FAR Subchapter D Part 23.2 states that federal procurement must take into account the aspects of energy efficiency and environment friendliness in each procurement. In spite of the special mention given to energy efficiency, throughout this chapter, cost efficiency has been provided as an innate principle that needs to be kept in mind while determining the worthiness of a product/process. Though FAR does not describe this policy and its rules in detail here, this aspect of US government policy has been discussed in detail below at the Agency and Sector level.

FAR Part 35 separates acquisitions with the sole purpose of research and development from acquisitions for direct benefit of the government. Though FAR Part 35 provides for this distinction, the same rules of acquisition apply to both types of federal procurements.

FAR Part 48 mentions value engineering as the main evaluation method. This method is used to apply ‘best value’ as the main evaluation criteria.

II. Executive Orders, OMB Circulars and Memos
The Office of the President issues Executive Orders as binding instructions for officers of federal agencies. The Office of Management and Budget (OMB) at the White House, similarly, issues circulars and memorandums on administrative matters for federal agencies. The Office of Federal Procurement Policy (OFPP), which is a part of the OMB, is responsible for issuing such procedural guidance for federal agencies regarding procurement matters. These Orders, circulars and memos, though not the rule of law, become procedural guidelines for federal agencies and thus impact the application of rules laid down by the
For the purpose of this study, we looked at all Executive Orders, circulars, policy letters, guides and memos released by the Office of the President, and OFPP of the White House in the last five years (from 2006 to 2010) that related to federal procurement in order to establish possible relationships between innovation and procurement policies. Annex A lists the circulars and memos directly relevant to our study.

The three categories identified to link procurement and innovation included the development of accessible technologies, improvement of space technologies, and the development of environmentally friendly products. The Government encourages the procurement of innovative solutions and development of innovative solutions by contractors to meet these ‘other’ social needs. However, direct reference to developing better technologies through federal procurement was found only in one Executive Order, Executive Order 13423. In this order, among many other goals for agencies, the federal agencies were given a goal to acquire sustainable, environmentally friendly, and green products. A more detailed discussion of this goal of the state and their performance is discussed in Section II, ‘Sector Based Practices’ under the sector environment.

III. Agency level acquisition guidance
More than 50 federal agencies are involved in activities that require acquisition of goods and services. Each agency has a fair amount of discretion in setting down its standards and procedures under the wide umbrella of rules laid down by FAR, as discussed above. FAR Subpart 1.4 provides for issuing regulations and policies that deviate from FAR if required by the Agency.

Mostly all agencies have an in-house ‘Office of Acquisition’ that provides guidance to the agency on procurement issues by interpretation of FAR, Executive Orders, and OMB circulars and memos. Other important roles played by the Office include approval of specifications for procurement and overseeing the competitive bidding process. The discretion to state the actual specification for the procurement remains with the technical heads of the agency placing the order.
For Part I of this study, we chose to look at the acquisition mechanism of five federal agencies that have a fairly large share of federal procurement and that refer to areas or sectors of interest to the present study. These include the Department of Energy, the Department of Education, the Department of Health and Human Services, the Environment Protection Agency, and the Department of Interior.

In this section, we will only provide a brief snapshot of each agency. The detailed procurement practices followed per sector will be discussed in Section B, Sector Based Practices.

a) Department of Energy (DoE): Energy independence and development of alternative energy technologies has been a national concern and an important issue in presidential elections in the last few decades. The US puts a lot of emphasis on energy independence, thereby making innovations in the field of energy a high national priority.

As in the case of all other agencies, DoE is subject to FAR for general rules on procurement. However, for its specific acquisition purposes, DoE has developed the Department of Energy Acquisition Regulations (DEAR).

DEAR is formatted to incorporate most of the FAR rules and has a similar order of the procedural regulations. Part 935, as in FAR, refers to additional procedural requirements for research and development contracting. However, the only purpose of this section is to lay down additional reporting requirements for contracting done with a purpose of research. The discretion of deciding what to procure and with what specifications continues to vest in the head of the agency or the procurement source.

b) Department of Education (DoEd): Education is generally managed at the state level. However, the federal DoEd is responsible for setting down standards and rules that need to be followed by the states in order to receive federal funding for education. In addition to the policing role, DoED also invests in developing better and improved learning methodologies.

DoEd’s Office of Chief Financial Officer, through the Contracts and Acquisition Management group, is responsible for procurement. DoEd has also tailored the FAR for its purposes into the Department of Education Acquisition Regulation (EDAR). The regulation is similar in structure and content to FAR, and simply modifies the words and definitions to suit it needs while maintaining the rule itself. No special mention or interest has been given to innovation. The decision on whether to make innovation a criterion in procurement lies on the department requesting the acquisition.
DoEd has an ongoing grant program entitled Investing in Innovation (I3) launched under the American Recovery and Reinvestment Act of 2009 with a focus on developing innovative techniques to improve school performance. Though this program is executed by the Office of Innovation and Improvement and is designed as a grant, it provides the much-needed insight into the US government’s policies regarding promoting innovation for improving everyday lives. Through this program, the DoEd requests assistance from schools, local level educational bodies and non profit organizations to use their proven innovative techniques in education to develop innovative programs and strategies. The total amount to be disbursed in this sector is $650 million dollars. **The main objective is to improve school level performance for children. Innovation is promoted indirectly under this main objective.** Though this program is directly relevant to our study, it is shaped as a grant, and thus does not qualify as procurement backed innovation. Therefore, one needs to be careful while discussing this example under procurement as different rules apply to procurement and grants.

c) Department of Health and Human Services (DHHS): Even though the US has ranked no. 1 for health spending per capita in the past; the rank of its health care system ranks nowhere near that according to a World Health Organization study. There is a need for innovation in not only the medical procedures and cures for diseases, but also in offering medical services.

Procurement is administered at the DHHS through the Office of Grants and Acquisition Policy and Accountability’s Division of Acquisition. Like other federal agencies, DHHS has also developed a custom version of FAR known as the Health and Human Services Acquisition Regulation (HHSAR).

HHSAR, like the custom version of regulations developed by other agencies, provides specific procedural rules to be followed during procurement. However, no specific policies or guidelines have been provided to include specific criteria in a scope of work. **The scope of work and its content is to be based on the needs of the agency that are being met through the procurement with the overall FAR principles of ‘best value’ being implemented through value engineering.**

d) Environmental Protection Agency (EPA): EPA is probably one of the most important agencies covered in this study as its core mission represents a social cause considered as one
of the essential driving forces for innovation in the country. The focus on innovation seems to be linked with other social causes rather than simply a desire to innovate. Innovation is promoted in all fields including energy sources, construction material, and even cleaning supplies in order to develop environmentally friendly products and processes.

EPA conducts its procurement through the Office of Acquisition Management, and like all other agencies, has developed its own in home version of the FAR called the EPA Acquisition Regulations (EPAAR). The agency follows the general principles of ‘full and open competition’ and cost effectiveness in all its procurements. However, in addition to following the policies laid down by FAR, EPA is also responsible for laying down policy and issuing guidance for all federal agencies under Title 40 of the Code of Federal Regulations, Clean Air Act, Clean Water Act, Energy Policy Act and many more. A complete list of the regulations that EPA administers can be retrieved here.

While performing its duties of administering the various regulations passed for protection of the environment, EPA takes up an important regulatory role in policy making. While EPA is limited for it’s own procurements by FAR, it also adds many regulations and limitations for other federal agencies to follow in order to meet its mission. The important policies developed by EPA that provide policy limitations for other federal agencies will be discussed in Part I Section B, ‘sector-based practices’.

e) Department of Interior (DOI): The Department of Interior is the federal agency responsible for development and maintenance of public infrastructure. DOI has many Bureaus and Offices under the umbrella that manage specific fields like land management, ocean energy management, fish and wildlife, surface mining, and many more. Each Bureau plays a specific
role and conducts its procurements under the guidance of the overall acquisition management system of DOI.

Procurement is administered by the Office of Acquisition of Property Management (PAM) as per the tailored version of FAR called Interior Department Acquisition Regulations (IDAR). However, as stipulated by FAR, procurement requirements are controlled to a very high degree by the acquiring agency. Even though PAM is the go to office for all Bureaus of DOI, each Bureau independently defines its needs and publishes its own list of procurements on their websites.3

STATE LEVEL PROCUREMENT

Each State government is independent to lay down its own rules for procurements conducted by the state agencies. FAR, Executive Orders and other regulating mechanisms discussed in the last section do not apply to state agencies giving them complete control for setting down policies for procurement as they see appropriate. State level procurement is generally either direct or sometimes, cooperative. Catalytic procurement is generally missing as the states mostly procure to meet their own needs. Similarly, adaptive procurement is more common than developmental because states appear unwilling/unable to absorb the risks of new innovation.

Although, it is not possible to study the policies put in place for all 50 states, this study looked at five states chosen on the basis of the level of interest in the field of innovation and the nature of in state businesses and their contribution to innovation. We looked at the procurement practices for the states of Maryland (MD), Virginia (VA), California (CA), Florida (FL) and Texas (TX).

I. State of Maryland (MD)

Similar to procurement at the federal level, the state of MD has developed its own procurement laws and regulations. Title 11 to 16 of the State Finance and Procurement section of the Maryland Code provides rules for acquisition. Further, Code of Maryland Regulations (COMAR) lays down procurement regulations in Title 21. The Department of Management and Budget (DBM) is responsible for procurements on behalf of the State.

Even though MD has put in place procedures through the mechanisms explained above, it follows the same pattern of not controlling the substantive policies behind each procurement. Each agency or department independently defines its mission and objectives. In order to understand the underlying culture in the state agencies of

---

3 Examples of independent acquisition information published by bureaus are a) Bureau of Ocean Energy Management and b) US Fish and Wildlife Service
MD, we looked at the Department of Information Technology (MD DoIT) and their policies.

The MD DoIT is very active in improving the existing systems of the Government by providing better support technologies. The Director for Policy and Planning releases a yearly master plan to lay down the objectives and discuss the past achievements in the field of IT for the state. On reading the Master Plan for 2012, it is evident that improved performance and better technologies lie at the heart of the department. Though innovation is not expressly listed as a priority, the master plan mentions focusing on specifying procurement needs to avoid redundancy in operating systems. The recent achievements discussed in the plan also describe the culture and direction taken by the MD DoIT as heavily depending on new technologies and systems.

In addition to the above, MD has many different agencies and departments that seem to encourage and support businesses based on new technologies. The MD Biotechnology Center under the MD Department of Business and Economic Development, and the MD Technology Development Corporation (TEDCO) are two such agencies created and managed by the state that support businesses that invest in technology by providing commercialization support and information resources.

It is also important to mention here that MD has a detailed 10-year plan called BioMaryland 2020 to support growth of biotechnologies in MD through various initiatives. Though procurement of improved technologies is not listed as an express method to achieve the objectives, this plan provides an insight into the culture of the state agencies and their objectives.

**Even though Maryland does not provide specific guidance to use procurement as a tool to promote innovation, it does possess an inherent culture to promote innovation that seems to penetrate all functions of the government including procurement.**

II. State of Virginia (VA)

In the State of Virginia, procurement is managed by the Department of General Services. The main regulation followed by the state agencies is the Virginia Public Procurement Act.

No information available from the departments hinted on an overall focus towards promoting innovation in VA. The policies and procedures did not indicate innovation or improved performance as a priority directly or indirectly. The culture
found in the neighboring state of MD seemed missing in VA and the focus remained on simply promoting state businesses instead of state businesses involved in technology innovation.

The IT Department of VA called Virginia Information Technology Agency (VITA) did list projects specifically investing in technology for various agencies. However, the underlying factor in such projects seemed to be agency need instead of the department’s own focus on innovation. Instead of developing an internal strategic plan like MD DoIT, VITA requires all agencies to submit a ‘strategic plan’ to them which forms the basis for approval of technology improvement projects.

III. State of California (CA)
CA conducts its procurement through the Procurement Division under the Department of General Services. The main policy regulations that are applied to state procurements are written down in the State Contracting Manual (Volume 2). This Manual was different from the regulations studied for federal or other state procurement as it focuses on many special programs like supporting veterans, women, and disabled individuals in businesses through procurement. There was no mention of technology or innovation in the manual that could suggest a focus on improving technologies.

Further, on a review of other agencies of CA, there was no specific evidence towards a culture supporting innovation. Though the Office of Technology Services (OTECH), like the IT departments of other states, did have a strategic plan, innovation or focus on promoting technology did not seem to be as strong a theme as found in MD.

IV. State of Texas (TX)
The state of Texas has one of the most comprehensive state level procurement laws in place. While Texas Government Code (TGC) Chapter 2155 and Texas Administrative Code, Title 34 Part 1, Chapter 20 Subchapter C lay down the routine procedural requirements like all other regulations discussed above, TGC Chapter 2158 lays down more specific limitations on procurements.

One of the more unique features of this chapter is the requirement for cars running on alternative energy sources. Further, the state binds itself voluntarily by environmental standards released by the federal EPA, thus showing its commitment towards more environmentally friendly technologies.
TX follows the trend noticed in the federal agencies. Though it does not specifically go for innovation as a condition in procurement, TX aims for innovation through procurement in order to meet other social purposes like environment and energy conservation.

V. State of Florida (FL)

FL conducts its procurement through the Purchasing Division of the Department of Management Services. The governing statute for public purchasing is Florida Statutes Chapter 287. FL statutes focus on procedural requirements. The three main policy considerations listed in Chapter 287 are efficiency, economy, and energy conservation. Innovation is neither a driving principle, nor a cultural focus for the government.

On researching the Agency for Enterprise Information Technology (AEIT), the IT agency for the FL government, it seemed that FL is a newcomer in the area of innovative IT solutions. The website for AEIT attributes its involvement in the procurement function to changes in the legislature made in 2010. Thus, FL has just started to catch the bandwagon of updating its technology whereas other states seem to be way ahead in this process.

SECTION B

SECTOR BASED PRACTICES

ENVIRONMENT

Environment has been one of the biggest concerns for the country for a long time. This has given Environmental Protection Agency a special place among federal agencies. The agency has been
given numerous powers to regulate and administer laws and regulations that affect the environment.

The tendency to develop innovations to achieve a social cause is more visible in the environment sector than anywhere else. Concerns for clean air, water, and other natural resources along with the need for alternative clean sources of energy makes this sector very active in research and innovation.

Further, one of the most important functions of EPA is to provide the basis for focus on innovative public procurement in this sector. In turn, public demand for innovative products sends strong signals to private users. Thus developmental catalytic procurement becomes the heart of procurement in this sector with the aim of market creation, escalation and consolidation. Public procurement in this sector is one of the best examples of innovative public procurement in the United States.

In order to administer the numerous regulations and executive orders affecting this sector, EPA releases guidance in all fields including clean water, clean air, clean energy etc. Most of these regulations are aimed at the private sector.

EPA plays various roles:
I. Law making: EPA defines and sets regulatory standards for environmental practices on the basis of the laws and orders provided to them from the government.
II. Policing Role: EPA is responsible for checking that each rule laid down by the law is followed by all in the private and public sector.
III. Resource Library: EPA provides numerous resources to industries and other public agencies in need of information and guidance for making their facilities more environmentally friendly. It is in this role that EPA becomes an important partner for other federal agencies in meeting the requirements put on them.

The US government, in its attempt to lead by example, implemented Sec 6002 of the Resource Conservation and Recovery Act which requires federal agencies to acquire as many recycled materials as practically possible. This law has been encouraging all federal and state agencies to take up this social cause. Annex B provides a list of such state efforts (source: National Governor’s Association Report) where commitment to EPA’s motto and partnership with EPA has promoted innovation through green procurement.

The environment is thus a hot bed for innovation, mostly due to the requirements on government agencies to do their part through procurement. This is a great example of how public procurement can be used to achieve a social cause. Even though the underlying social cause is not innovation, it directly affects the innovation and research nonetheless.
HEALTHCARE

Healthcare and healthcare delivery have been hot topics in the country over the last two years, mostly because of the major health reform passed by President Obama. In the public sector, focus seems to be more on healthcare delivery. **Innovation, at this point, is mainly focused on healthcare delivery aimed at improving the poor state of healthcare services for many Americans.**

Not much innovation is being fueled through procurement. Many programs/funding have an effect on the technologies used in the field and thus qualify for an innovation funded by public money. The healthcare reform has many such small programs that affect healthcare delivery in many ways. Though it is not possible to discuss at length each program and its effects on innovation, an example of a $100 Million dollar program launched by the Department of Health and Human Services Secretary helps explain the picture. This program launched in 2009 gives money to 10 states to test innovative technologies in healthcare delivery for children.

**Such programs, though not procurement, help promote innovation by focusing on social causes in need of innovative ideas and technologies.** However, as they are not administered in the form of procurement, the regulations affecting their administration are very different. Thus, it requires caution while discussing such programs under examples of innovation-based procurements.

ENERGY

Energy, like the environment, is a sector attracting a lot of policy attention regarding the need for innovation, especially in relation to competitiveness and energy independence. The Department of Energy spends 90% of its budget on a variety of contracts and federal assistance agreements. This makes this agency unique. Even though, like other federal agencies, DoE does not have a law requiring them to invest in innovation, their basic mission and intra-agency culture seems to put innovation at center stage.

Like environment, developmental public procurement is the main form of innovative public procurement used by the energy sector. The aim is to use cooperative and catalytic forms of public procurement for market creation, escalation and consolidation. Purchasing by state and other public actors in this sector is directed not only towards fulfilling their own original missions but also towards influencing and supporting certain patterns of demand on the part of private consumers.

Figure 2 below lists DOE commitments made to commercial organizations last year.
The energy sector invests a lot on innovation and research. The DoE goes a step further and provides its contractors with direct support to commercialize these technologies. This was the first federal agency website that we came across which provides names and links to all its contractor’s websites and encourages visitors to contact these contractors for business opportunities. This unique feature provides exposure to new technologies and helps integrating them into the economy.

INFRASTRUCTURE

Infrastructure is affected by actions of many federal agencies. The main federal agency responsible for the country’s infrastructure is the Department of Interior. Due to the wide variety of items covered, the DoI has been divided into many small bureaus and offices that are individually responsible for land management, ocean energy management, wildlife and fisheries and so forth.

---

4 Source: Department of Energy website
There is a vocal recognition in the US government of the deteriorating condition of the nation’s infrastructure and a push to prioritize its development. The application of new technologies is seen as a consequence.

DOI spends one-fourth of its budget on small contractors for regular infrastructure maintenance based assignments. In addition, the 2009 American Recovery and Reinvestment Act gave the Department of Interior extra money to invest in infrastructure. The main objective was job generation and fighting unemployment.

Though DOI spends significantly on infrastructure, most of these investments come across as regular everyday maintenance jobs rather than new technology development. The agency does not indicate the same level of enthusiasm as in the energy and environment where innovation is at the heart of all activities.

To conclude, there are differences among sectors in terms of promoting innovation through public procurement. In all cases, innovation is seen as a means to achieve worthy social objectives. It is these social objectives that push agencies to innovate and to promote new technologies.

SECTION C
SMALL BUSINESS INNOVATIVE RESEARCH PROGRAM

A very interesting example of public fund set-aside to explicitly procure innovation is the Small Business Innovation Research (SBIR) Program. Not only is funding available for risky research leading to innovation, it is the explicit objective of many federal agencies to assist SBIR award small firm recipients to market their innovative products to them, other public agencies, or to the open market. Many countries around the world have now replicated the SBIR one way or another. This SBIR program is only peripheral to this report.

SBIR was established by the Small Business Innovation Development Act of 1982. The program has been reestablished periodically and continues to provide funding to small business for innovation-based research. The four goals for the program listed in Sec 2(b) of the Act were:
1) Stimulate technological innovation
2) Use small business to meet federal R&D needs
3) Foster and encourage participation by minorities and disadvantaged persons in technological innovation; and
4) Increase private-sector commercialization innovations derived from federal R&D
SBIR eligibility is limited according to the following requirements:

- U.S. business organized for profit
- All R&D must be performed in the US
- At least 51 percent US owned and independently operated (subsidiaries of larger companies and companies majority owned by venture capital funds not eligible)
- 500 employees or fewer, including affiliates
- Investigator’s primary employment (more than 50 percent commitment) must be with the small business concern at the time of award and for the duration of the project.

The program is divided into three phases (Table 1)

**Table 1: SBIR Phases**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Objective</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase I</td>
<td>To test scientific, technical, and commercial merit and feasibility of a concept</td>
<td>6 months up to $150,000</td>
</tr>
<tr>
<td>Phase II</td>
<td>To develop the concept to a prototype stage</td>
<td>2 years up to $1 Million</td>
</tr>
<tr>
<td>Phase III</td>
<td>Commercialization</td>
<td>No SBIR funds</td>
</tr>
</tbody>
</table>

Presently, 11 different federal agencies are involved in promoting research through SBIR. A list of the agencies executing SBIR is given in Table 2 below.

**Table 2: Federal Agencies executing SBIR**

<table>
<thead>
<tr>
<th>Department of Agriculture</th>
<th>Department of Homeland Security</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department of Commerce</td>
<td>Department of Transportation</td>
</tr>
<tr>
<td>Department of Defense</td>
<td>Environmental Protection Agency</td>
</tr>
<tr>
<td>Department of Education</td>
<td>National Aeronautics and Space Administration</td>
</tr>
<tr>
<td>Department of Energy</td>
<td>National Science Foundation</td>
</tr>
<tr>
<td>Department of Health and Human Services</td>
<td></td>
</tr>
</tbody>
</table>
Each agency has its discretion to define its research needs and to fund the kind of research they think appropriate through SBIR. This right provided to agencies is similar to the discretion given to agencies in regular procurement to define the specifications according to their own needs. **Thus, while federal law defines the procedural requirements of the program, the technical requirements for the research are still defined by the funding agency.**

Over the past three decades of the program’s life, the Government Accountability Office (GAO) has conducted various evaluations of the program providing numerous recommendations, most of which are generally met by Congress, at the time of reinstatement of the program. The most important drawback of the program pointed out by GAO is its inability to develop usable data sources from the program, thus making impossible to evaluate its effect on innovation.

The National Academy of Science (NAS) conducted a detailed evaluation of the program and published a detailed report in 2008. This study’s findings were quite different from that of the GAO. According to the NAS, SBIR actually achieves its purpose of promoting innovation, supporting small businesses to innovate, promoting participation by minorities in innovation, and promoting private sector commercialization. The NAS does acknowledge that the program does not have good reporting and recording techniques and needs to improve in these areas to facilitate effective evaluation and analysis of the program.

Overall, available empirical and anecdotal evidence indicates that SBIR seems to assist many small firms innovate. However, as far as the present study is concerned, the bulk of SBIR is not procurement. Procurement only kicks in at Phase III, where no SBIR funds are provided for activities. **This program creates opportunities for procurement to promote innovation even though it is not procurement itself.**

**SECTION D**

**EXAMPLES OF SUCCESS AND FAILURE**

An overall policy for promoting innovation through federal procurement is absent in the United States. However, federal agencies have a significant degree of autonomy in deciding the substantive part of their procurement, define the content and the evaluation criteria. They thus promote innovation (to a variable degree) in the effort to achieve their social objectives.

This Section offers a first glimpse of cases of innovation achieved through public procurement. We’ve used the most recent reports on procurement issued by the Government Accountability

---

5 Source: [Government Accountability Office](https://www.gao.gov)

Office (GAO), the federal agency that evaluates all federal spending programs and comments on their success or failure. One of the five cases discussed below is a direct procurement request and guidance from the OMB for innovative procurement.

I. The Integrated Disability Evaluation System (IDES)

IDES was developed in response to the National Defense Authorization Act of 2008 which required the Departments of Defense (DoD) and Veterans Affairs (VA) to develop a joint strategy to improve service to disabled veterans leaving the services. GAO’s evaluation report discusses in detail the need for this system and its achievements. The need for innovation was fueled by the social objective of simplification and integration of two separate compensation schemes for war disabled veterans. In order to achieve this need, the DoD and VA needed to develop a new integrated system with innovation in IT systems and innovative processes of evaluation. Giving discretion to agencies to determine their needs and procuring innovative solutions accordingly was at work behind this program and its focus on innovation.

II. Investment in Transportation Systems

GAO conducted a detailed study of the improvements made in the transit systems around the country with a focus on studying state’s response to handling increased traffic during the period 1998-2008. Among other things, the GAO’s report discussed the various federal grant programs that were put in place to help states and cities invest in improving their infrastructure. Through this federal program, innovation was promoted in the kinds of vehicles/methods of transit, existing and proposed facilities and equipment, new and fixed guideway systems, and safety and security of transportation systems. The programs in this report are unique in that the federal grants programs and their implementers were asking for innovation in transit systems. Importantly, the need and the kind of innovative solution implemented by every city were independent for each city/region and were defined by their own agencies needs.

III. Forestry Services R&D Application

Since the early 1900s, the Forestry Services has been involved in high level research that helps mapping the resources owned by the country and maintaining a balance in the environment through mapping species, weather patterns, and through providing essential information regarding natural hazards like wildfires. GAO, in a study published in October 2010, found that even though the Forestry Services were conducting a lot of relevant and important research leading to innovative solutions for climate and wildfire predictions, this research was not being translated into real time tools and information for the states and other relevant officials who could use it for
practical purposes. This identified shortcoming resulted in recommendations for increased stakeholder involvement and coordination with other agencies.

IV. Space Technologies Commercialization
In November 2010, GAO published a study evaluating the effectiveness of the commercialization techniques used by DOD to transition technologies developed under its Small Business Innovation Research (SBIR) program. The study evaluates the steps taken by DOD to introduce technologies developed by small businesses for the space program into the commercial market through acquisitions and other methods. GAO’s findings reflect that DOD falls short in its efforts, especially because, instead of following some well-defined method, the approach was casual and case dependent. Failure to commercialize and the high costs involved in developing innovative technologies for space created burdens for the small businesses involved.

V. Partnership Fund for Program Integrity Innovation
The OMB, in October 2010, released instructions for federal agencies to solicit pilot programs for innovative techniques in federal assistance programs. This includes grant type programs and general federal procurement. The program described in this OMB memo referred to developing innovative ways of financial management in federally funded programs and procurement. OMB realized a need for improvement in management of finances by its agencies, which led to a commitment of $37.5 Million towards developing innovative financial management techniques. Once again, the purpose behind this federal funding was not the promotion of innovation in financial management, but a social need for such innovation due to reported failures in this field.

SECTION E
CALLS FOR REFORM

Procurement reform has surfaced as an important topic over the past couple of decades. Two recent important reports are listed below.

A) Government Accountability Office Report
GAO presented a report on November 8, 2010 discussing best practices in acquisition and comparing them with common government practices. According to this report, current practices push unknown risks to later stages of the program, which increases the risk and money involved in technology development. GAO recommended that
unknown risks must be confronted at the initial stages of a project in order to reduce risks of failure.

B) National Procurement Fraud Task Force Report

The US Department of Justice formed a Legislative Task Force to prevent fraud in federal procurement in 2006. The Force submitted a White Paper in 2008 summarizing their proposals for reducing fraud and promoting fairness in federal procurement. This paper was submitted by Brian Miller, Inspector General of General Services Administration, and Richard Skinner, Inspector General of Department of Homeland Security. The main reason for this study was the steep increase in the government outlays during the period 2000-2007.

Recommendations mainly relate to processes and financial management within the agency and for the contractor. Further, the report promotes broader powers for Inspector Generals to adjudicate reported fraud matters. The strict guidelines being recommended for federal procurement could place an added burden on contractors in the form of higher administrative costs and possibly disqualify smaller contractors who do not have the ability to meet such strict guidelines.

To conclude, investing in innovation is a costly and risky enterprise. **Increased emphasis on cost and risk minimization may discourage innovation.** Similarly for tightening financial management which adds administrative burdens which may prohibit the most innovative organizations to participate.
PART II: CASES

In the second phase of the study the research team tried to verify the clear messages emerging from our independent analysis, presented in Part I of this report. We started quickly and by early November we had pretty much identified the people we wanted to approach in important federal research agencies – that is, agencies whose mission drives them to procure new technologies either through buying of goods and services from independent contractors for their own internal use, or through their support of the research and production of such goods and services for the benefit of society at large. These people were the chief procurement officers and we attempted to set up interviews in person to (a) discuss our basic findings and ask whether they agreed with the general principles and (b) identify innovative procurement practices in their agencies and, to the extent possible, specific cases of procurement of innovative products and services from the private sector.

We tried to focus our investigation on the procurement of actual goods and services. However, as is well known in the literature on technological change, only in very rare occasions one project will lead to one innovation. The relationship is rather many to many. Thus, while these officers talked to us about apparent innovations that came out of specific instances of procurement, in reality when we checked the records we found that most of what they talked about was the result of multiple instances of funding, some direct procurement, some research support, and even some support by agencies other than their own or even by the prior sector itself. This is the classic problem of “attribution”. Thus, the summary case studies presented later in this section should be looked at as purely indicative of the procurement climate, rather than well defined instances of cause and effect.

Our work was carried out in two phases. A round of interviews with chief procurement officers came first, followed by further digging out examples of innovative procurement mentioned by the interviewees.

During the winter and spring of 2011 U.S. federal agencies were interviewed and asked to discuss their procurement practices. The approach that was taken at this stage, was to fully understand the viewpoint of the Chief Acquisition Officers. As these are the individuals in each agency who oversee the procurement process, these are also the individuals who create the tools for others to innovate within. It follows, logically, that these would be the offices that are thinking and discussing how best to procure innovation.

The following agencies were contacted and correspondence regarding their agency ensued: NASA, Department of Energy, Department of Health and Human Services, White House Office of Procurement, Department of Commerce, Department of Health and Human Services,
International Trade Commission, National Oceanic and Atmospheric Administration, Census Bureau, and Department of Defense. Four formal interview transcripts are included below. The other agencies provided suggestions for cases, commented on the thesis, and allowed on-site participation in their meetings.

The list and affiliations of contacted individuals is presented in Annex B. Each of these individuals received a letter of invitation (example, Annex C) and an explicit set of questions (Annex D).

Summary Responses - Agency Interviews

I. Department of Energy

I. Overview

a. Briefly describe how procurement works in your agency (i.e. offices, leadership, publications, etc.)

Procurement authority within the Department of Energy (DOE) flows from the Secretary to the two Senior Procurement Executives. DOE is unique in that it has two SPE’s, one for the Department excluding the National Nuclear Security Administration (NNSA) and one for NNSA. The SPE’s in turn, delegate specified authorities at certain dollar thresholds to senior program managers or field office managers who serve as Heads of Contracting Activities (HCA). HCAs issue warrants to Procurement Directors who in turn appoint Contracting Officers who conduct the actual procurements within their limits of authority. The Department expends approximately 90% of its budget through a variety of contracts and financial assistance agreements making it one of the largest civilian departments in the federal government in terms of expenditures. Through these expenditures we impact a variety of industries, educational institutions and individuals across the nation. The majority of our contract dollars are expended through a relatively small number of large Management and Operating (M&O) contracts to run the Department’s network of National Laboratories, weapons production contractors, and for large site and facility environmental cleanup contracts.

b. To what extent does the central procurement office play a guiding hand in the procurement practices for the other offices in the agency?

The Office of Procurement and Assistance Management at DOE Headquarters plays an important role through policy direction and oversight of field procurement offices. Procurement actions at certain dollar thresholds must be reviewed and approved in advance by headquarters during what is called a business clearance process. Additionally, a headquarters led team periodically travels to the field offices to ensure compliance with regulations/policy and to identify and share best practices.

c. From FAR to your office, what if any, are differences in the agency and then to the different departments?
The Federal Acquisition Regulation (FAR) is a single, uniform regulation governing procurement at most executive agencies, including the Department of Energy. The Department of Energy Acquisition Regulation (DEAR) implements and supplements the FAR for the Department’s unique needs. Internal agency policies and procedures are also issued by the SPE via Acquisition Letters and the Department of Energy Acquisition Guide. Field offices may develop local policies and standard operating procedures as necessary.

II. Innovations within the Agency

a. Does your office have a specific plan to promote innovative practices?
The Department has a multi-faceted approach to procurement innovation. As with other Departments and Agencies, we are working towards advancing all of the Office of Management and Budget initiatives the focus on institutionalizing government/industry best practices. The OMB initiatives are focused primarily on federal prime contracts, however, the agency expends a large proportion of its budget through Management and Operating (M&O) contracts and other major facility contracts. Within this unique group of contracting we have advanced a number of innovative initiatives such as supply chain management to ensure our budgetary dollars are expended in the most effective and efficient manner. Our M&O contractors perform industry benchmarking and implement commercial best practices to ensure maximum value for our dollars.

b. Does your office encourage off-the-shelf products or are you looking for new solutions? How do your proposals and evaluation metrics tie to these questions?
The FAR requires federal agencies to conduct market research in order to determine whether commercial items are available that could meet the agency’s requirements, and to acquire them if they do. When commercial items are acquired the acquisition procedures and contract clauses are streamlined, resulting in simplified contract documents and shorter procurement lead-times.

c. To what extent are innovative practices, processes, or products discussed in the context of procurement?
Innovation within the procurement process is highly encouraged. When new approaches are uncovered during the business clearance process or the procurement management review process, they are shared with all of the procurement directors. In addition, we work closely with our M&O contractor procurement directors to identify and implement commercial best practices within their own acquisition organizations.

III. Example Innovations

a. Can you cite any specific examples within your agency that have led to innovative products or processes?
As discussed briefly above, an excellent example within DOE is the use of supply chain activities within our M&O contractors to maximize the benefits of each procurement dollar. We have several forums within the M&O community where they collaborate to identify common products and services and ultimately obtain better pricing through leverage procurement vehicles.
b. Why did the agency choose to fund the innovation?
The funding required for such activity was very minimal. The collaboration between contractor and federal acquisition executives was the driving force. Very little in the way of funding was required. The Department and contractors saw the potential lucrative benefits of collaboration, realized it was a commercial best practice and determined the necessity of implementation.

IV. Summary

a. Do you agree with the above thesis? (Top of questionnaire, Annex D)
In general, yes.

II. International Trade Commission

The government is moving away from custom specifications – ‘if it is good enough for consumers it is good enough for the government’. The government is told to take the “off the shelf” products. However, agencies may modify a product. So long as a modification is less than 50% then it is still considered commercial product.

There is a push in small agencies to centralize operations. Although this is talked about, it has not been done in any meaningful way to date. Contracts currently issued by the government are the result of a procedure initiated by agencies writing their requirements up front to very detailed specifications, pre-defining what they want and giving very limited ability for contractors to provide their own ideas.

This office is working on an innovative type of contract around IT needs. This new type of contract may be only at the early stages of development, but discussions are underway to move to “modular purchasing” where buying agencies are able to access the latest and best software continuously. Hence, this will not just be off the shelf, but it will open up to vendors an opportunity to provide their way to ideas and thoughts on how to provide the service.

Currently, the contractors are required to present a Statement of Work which should be short and concise and include the answers to the questions: When, Where, Who, and How? These are evaluated against pre-defined factors. Price is always a factor, but it is not the only one. Looking for the best value – freely determined - is another significant factor. ‘Cost realism’ is also often used to determine if the overall concept makes sense in answering what was asked.

Agencies have different cultures, which may make them decide very differently. As the Senior Procurement Executive, the interviewee is the only person who can override a procurement decision at his agency. He is the one who makes the decision on how to spend the available funds. The contracting office, in addition to having the source selection authority, has the final say.
When talking about innovations at the agency, the interviewee stressed the need for additional staff to take the burden of day-to-day operations in order to think more concretely about innovation through procurement.

Importantly, the interviewee had been hired from the private sector where he had worked for some time for companies responding to government requests, thus better understanding the needs of his current suppliers.

### III. Department of Commerce

The interviewee stressed – as did others – that the procurement setup should allow industry to collaborate for innovation. Industry needs oversight, a strict schedule, and the commitment of leadership to see the process through. Hence, procurement is currently being treated as a demand function in this department whereby costing and performance specifications must be determined whereas innovative solutions are left to the supply side (contractors). According to the interviewee, the buyer (demand side) can actually stifle innovation where the government has strictly and narrowly pre-prescribed what they want and the innovation cannot get out.

S.454 - Weapon Systems Acquisition Reform Act of 2009 was proposed as a successful example of costing done upfront. According to the interviewee, it is advisable for civilian agencies to work more like the DOD when it comes to acquisition, but the question remains as to how civilian agencies cost upfront.

http://thomas.loc.gov/cgi-bin/bdquery/z?d111:SN00454;@@@D&summ2=m&

The interviewee shared the example where engineers had to tinker and come up with an answer without being subjected to a straitjacket. He expressed his preference for the DARPA model, where innovation comes when funds are spent with oversight, on the one hand, but a significant degree of freedom is allowed to the contractors, on the other. He illustrated this example with the case of National Ignition Facility, a program that he had overseen several years ago. He needed a new type of fuel and got it from companies collaborating prior to the procurement being issued. https://lasers.llnl.gov/

The interviewee expanded on a model on acquisition which reportedly effectively works in the federal government. The pillars are the program manager, resources, and legal. Good communication among the different partied (e.g., program manager and legal services) is key. Good oversight, linked overall procurement policy through the chief acquisition officer is key. Up until the interviewee arrived at Commerce, the agency viewed acquisitions as silo’d – legal services, the program manager (chief acquisitions officer), and acquisitions did not work together and were not strategic about their resources. It is to be noted that Commerce has 12 Bureaus and Agencies and they each have their own procurement offices. Each is authorized to procure
without the approval of the DOC acquisition office for contracts below $75M. The interviewee has mandated a new process whereby managers are required to sign a costing and schedule affidavit so that they commit to what they propose. Having employees commit upfront to their promises has proved quite successful with management. Acquisition needs to deliver a required, affordable, timely product. The DOD acquisition process - emulated by the interviewee at the DOC - has three milestones and focuses on an event-based process rather than a calendar-based process:

1. Program Initiation: It needs a mission statement, risk assessment up front, a funding commitment and an independent cost review. These are all key to getting the requirement and scope right from the start.
3. Production, construction, contract approval: The implementation stage consists of updating risk assessment and program performance.

As in the previous case, the interviewee had spent significant time in the private sector prior to his tenure in the government. He prides himself on his industry background as an aerospace engineer. He had joined DoC only a couple of months before the interview coming from the Department of Energy’s Acquisition Office.

**IV. National Oceanic and Atmospheric Administration (NOAA)**

NOAA is the oldest scientific agency in the U.S. It has a mission to understand and predict changes in the ocean and atmosphere. The major focus on R&D is on weather and modernization. The annual budget is $5 Billion, one fifth of which goes to procurement (about 16,000 actions per year). Another fifth goes towards grants and cooperative agreements (about 4,000 actions per year). Procurement at NOAA ranges from the micro level at $3500 to very large multi-billion dollar satellites.

With regards to our thesis, Mr. Ross felt that it was generally correct that agencies with missions where research was embedded would come up with more new things. As NOAA is a scientific agency, innovation is a need and therefore is built in. He referred to a distinction between the process of procurement and the purchase of innovative products.

When discussing the procurement process, Mr. Ross mentioned that the Federal procurement system affords a lot of flexibility, yet it is a structured process. The process for procurement is common and recognizable across the federal government. Flexibility is built into the system,
which allows agencies to procure what they need fairly easily. It is this flexibility that allows NOAA to procure innovation within the process.

Mr. Ross responded to a follow-up question asking him to describe how NOAA specifically procures these new capabilities. He said the agency must decide whether to make or buy the capability first and foremost. You can ask civil servants in the agency to make it, but usually professionals within an agency have more breadth than depth. This in turn means that usually an agency turns to capabilities worldwide, where people specialize and offer the best and most cutting edge capabilities. The procurement life cycle they go through at NOAA involves a requirements definition, a validation of the scope, feasibility studies conducted, purchasing of a solution, evaluation of a proposal, and negotiation of the proposal.

Looking specifically at how NOAA writes in innovation into its procurement process, Mr. Ross said that it was quite difficult not to stifle industry while also trying to get what you want. He said that when they draft requirements, they use performance-based metrics. This allows those writing the requirements to describe the capabilities they want without prescribing everything. He felt that this was the key. Further, all agencies can do this; but they don’t. Going back to the mission comment made earlier, the reason they don’t all do this, is because their missions do not require them to. The downside to performance-based requirements is that you can sometimes end up with something other than what you need. This is due to the fact that you only set the capabilities. There is certainly a fine line between over and under specifying. He said that it was truly an art, and connected directly to the personnel managing the contract. Following, he said it is imperative that the agency has the right people in place, and that the agency is extremely dependent on those individuals.

Mr. Ross spent quite a bit of time discussing the need for a larger and highly trained procurement workforce. He mentioned that the amount of money has been doubled in the last ten years, and yet the number of employees has stayed the same. He went further to say that he does not just need additional staff, but staff that has been trained and certified.

Key Examples:
• NOAA is a large purchaser of high performance computing. Contractors are asked to push the envelope and give the most innovative solutions they can offer. They end of getting the latest and most capabilities by not over prescribing their needs.
• NOAA is procuring a new severe weather notification system. This system shortened the time providing advance notice of severe storms.
• At NOAA there was a move from Doppler radar to Dual Polarization. This gave much greater granularity for weather research. This allows researchers to measure individual droplets of water in terms of size.
• NOAA is creating an Ocean Explorer – Remotely Operated Vehicle. These autonomous ocean vehicles allow researchers to view marine life at depth.

V. Office of Federal Procurement Policy Workshop

Members of our team were invited to attend a meeting between federal agency procurement officers – also including representatives from OFPP, OMB, GAO – and representatives of industry responding to procurement requests. The meeting took place on March 2, 2011 and was hosted by the White House Office of Federal Procurement (OFPP).

The meeting aimed at communicating the implementation of significant changes to federal procurement policy. In this regard, OFPP released memo highlighting a list of “myth busters” early in 2011. In this meeting, the OFPP was asking IT companies how they felt about moving to “modular” contracts, what they considered innovations in the system, and what they would do to change the IT system for the better. This was the first meeting of its kind. IT is considered the sector where policy changes can have a broad impact.

The two areas of focus for this meeting were: modular contracting and establishing a new and well trained acquisition workforce.

A. Modular Contracting. The conversation focused on the definition of modular and the contractor’s reaction to the option of modular. When should it be used? Specifically, how does one negotiate this type of contract and how do the requirements match with costing. The federal government representatives were looking for case studies and examples of successes.

What type of contract would modular work best on? Individual programs versus large enterprise systems? The IT industry operates in systems. The suggestion was the change the mind-set away from one award given every 60 months to adding in milestones with yearly deliverables that are contingent on payment. From lessons learned, organizations are more willing to change if they have experienced a large failure. As articulated by industry, it is very rare to see contracts offered with small contract pieces. Usually what is offered are only extremely large contracts – However, it was made very clear that even if modular contracts were used, there needs to be an overarching strategy for each contract that would have the larger picture in mind. If contractors are allowed to compete on smaller pieces of a contract, then folks can learn best practices of what went right or wrong and the government has more power to hold the contractors accountable. There was a large concern the contractors would then be able to “pass the buck on blame” if this strategy was not thoughtfully implemented. In the end it really depends on what you are buying and all agreed that they still needed oversight and checks and balances, as well as the ability to fire contractors.

Modular contracting seems to be more than just creating ‘gates’ for re-competition for federal agencies. It appeared that this is the conduit they are using to keep at the cutting edge and to be
able to get the desired products/services that will actually help them when delivered. Given that the time gap between issuing the RFP and delivery of the system could be five years, the room for error (obtaining the ‘wrong’ product at the ‘wrong’ point in time) is significant when technology is involved.

A very interesting part of this conversation came from the industry response to the question of the “number one thing the feds can do to improve the success of implementing large contracts." The answers were very unanimous. Industry felt that there were major problems with the protest process. The ability for protests to take place after contracts were awarded is said to be the reason why contracts do not occur on time and why they cost as much as they do. Industry and the procuring officers seem to be very weary of the protest process. The other core issue is about communication around writing the requirements of contracts. This is seen as the key to both creating innovation and having contacts be successful. The industry felt that if the federal managers were willing to include them in the conversation – i.e., well before the specification were drawn up – then that it would make a tremendous difference in allowing the federal managers to actually get what they want and at better price. It is a very interesting cycle. Currently, federal employees write the requirements of systems that they want in the future. They do not ask industry if the requirements they are writing are current, correct, or the best way to create the system. As a result, industry creates what is asked of them regardless of whether it is the best or the right thing to do. The industry representatives insisted that if they could be brought in earlier to the conversation, during the requirements stage, they would have a voice in assisting with shaping and understanding what the government really wants. This, of course, was hardly a surprise to us given the current trends of product design and contracting in the private sector. More surprising was the fact that the public sector is still far from that stage in public procurement practice.

A former executive at Xerox present in this meeting had a distinctive approach. He felt that procurement should not be defined by the technology that the agency seeks but rather by their business need. It should be about filling a need and allowing the company’s to innovate in order to fill that need. This is counter to the typical federal agencies’ pre-setting the scope and requirements. The FAA SAVES Program was given as an example of this type of method. The program was identified as an example because it was up to the vendor to say how they met the stated requirements of the agency. This example would deserve a more detailed case study.

**B. Acquisition workforce.** The meeting reinforced the opinions expressed in our interviews that the proper training of a significant workforce for acquisitions is particularly important. All federal agencies are very much in need. Importantly, there is a lack of formal programs in universities and colleges for this specialization.
VI. Additional Comments from CAO Interviews

The Chief Acquisition Officers in federal agencies do speak about ‘innovation.’ They rather, however, talk about innovations in the process of procurement. Almost every acquisition officer that we spoke with is evaluating and thinking about how to make the procurement process more efficient, to create cost savings, and to better align the process of their RFP’s and the end products that are received. These are obviously not new topics, but it was clear that the Obama Administration has taken an interest in this area, and has been pushing for changes. The White House Office of Federal Procurement Policy (OFPP) has created committees with large and small agencies to discuss what they refer to as “innovative procurement practices.” The discussions are new and the teams have been meeting for less than a year. The common topics of interest on the table are on leveraging the purchasing power of the federal government, creating a cloud computing system, training the incoming generation of acquisition officers, and learning from business to understand how to have the government get what it actually wants.

It was discussed numerous times in various settings that the key point between the success and failure of an acquisition is in the writing of the requirements. More than anything else, this area seems to provide the connection between the procurement tools and the acquirer’s needs. There is a major conflict, however, in the procurement process. This conflict has to do with fairness, and a fear of the litigation that may ensue after the selection of an awardee. To defend against litigation, most procurement officers have a tendency to over-specify the requirements of the product or process that they need, rather than allowing those in the field to bring the latest technology to the table. Overspecification stifles innovation.

In our discussions, there were a few examples where the procurement process worked well. The delivered product or system had never been created before, and yet was state-of-the-art while meeting the needs of the agency. When asked specifically to draw upon the lessons learned from those examples, the answers were a bit too obvious and a bit unnerving if one looks for systemic approaches. The actual process for procurement appears to be fairly similar across the agencies. That is not to say their content is the same but the processes have a number of noticeable similarities. A procurement usually arises from a need within the agency. A program director will alert the procurement office that they have the budget to put out a solicitation to fill that need. At this point it is either the program director, the acquisition officer, or many times the two working in concert’s job to write the specifications for the solicitation. It is unclear what the background of either individual is when writing the specifications. This becomes a very human and very personal issue. There is no process in place from the procurement perspective to ensure that the person writing the specifications truly understands what they want up-front. Going back to the successful models, each time the success could be pinpointed to a specific person that made sure the procurement was successful. This person usually reached out to businesses and sought advice upfront and then really made sure the project remained a priority and worked closely to make sure it was offering what was necessary. From both the business perspective and the federal perspective, both said that the communication between the parties, upfront and during the process, it really key to success.

From the conversations that took place, it became quite evident that the procurement officers put a heavy emphasis on the tools they use, rather than the content that is included. So long as
protocol is met, then the program directors have significant freedom in what they purchase. When asking about innovations, specifically, each agency approaches the need for new things differently. If an agency’s mission includes scientific research, it appears that when they create a solicitation, they are more willing to describe what their needs are and allow proposals to suggest the method for reaching those goals. Further, in many of these agencies, innovative strategies are included as part of the reviewer requirements. This is certainly the case at NASA and NIH. Most of the procurements from both agencies are left fairly open. However, as it is the job of the procurement officer to make sure the solicitation and the award are successful, it takes the senior leadership of the specific agency to dictate this tone. If the leadership’s focus is around cost savings, or minimizing the number of appeals, then the procurement office will be less willing to allow broader solicitations.

It appears that over the past 18 months, a transformation has begun. Through the OFPP working groups, a community of procurement officers has formed. Many realize they are facing the same issues and that they are not taking full advantage of the flexibility FAR provides and the power that is at their fingertips. There will likely be a more strategic push in the near future from this group to change to procurement process, where they are the ones proactively fostering innovations.
Instances of Innovative Public Procurement

I. Census Bureau: TIGER System

Background

According to its mission statement, the Census Bureau serves as the leading source of quality data about the nation's people and economy. The Bureau conducts the U.S. Census which counts every resident in the United States. The census is mandated by Article I, Section 2 of the Constitution and takes place every 10 years.

Prior to the 1960 census, enumerators of the Census Bureau visited each household in the U.S. and asked the residents to fill out a questionnaire. In order to avoid duplications and speed up the process, the Bureau provided enumerators with maps, showing the assigned area. In the late 1960s, the Bureau developed Dual Independent Map Encoding (DIME), a geographic information system to handle spatial data. Despite successful implementation of the GBF-DIME files of major metropolitan areas many problems were encountered during the 1980 census due to the fact that three basic components of geographic support – a national address list, geographic reference files, and maps – were not coordinated which resulted in numerous problems during field operations, tabulation, and data dissemination.

In order to reduce the likelihood of future problems and ascertain consistency among and between geographic support functions and products the Bureau embarked on an ambitious project to create a national digital spatial database to support the next two decennial censuses.

Development of the TIGER System

At the August 1984 11th International Cartographic Conference Robert W. Marx, then Chief of the Geography Division at the U.S. Census Bureau, presented a paper describing the agency’s concept for a seamless nationwide geographic database that would facilitate the collection, processing, dissemination, and understanding of statistical data about the people and economy of the United States.

The new database would contain information about all the physical features commonly found on the maps used by the Bureau’s enumeration staff (e.g., roads, railroads, and selected landmarks), the street name and address range information required to automatically geocode most city-style addresses and associate each with the road along which it was located, and all the geographic

---

boundaries, codes and names for the governmental units and statistical entities used for interviewing/data collection and delivery of the tabulated statistical data.

Although the concept seemed radical and unlikely of success the Geography Division broke new ground by developing a valuable national resource to assist in conducting the census, the Topologically Integrated Geographic Encoding and Reference System-TIGER geographic database.

TIGER is the system and digital database that supports the decennial census and other Census Bureau statistical programs. The topological structure of the TIGER database defines the types, locations, names, and relationships of streets, rivers, railroads, and other geographic features to each other and to the numerous geographic entities for which the Census Bureau tabulates data from its censuses and household surveys. TIGER expanded earlier efforts in digital spatial database development and emerged in a fundamentally operational state in only six short years. It was viewed not only as a data repository but as a “system” which included the data, the database, all software applications, documents and procedures. The TIGER database does not contain demographic data but merely the map data such as street address ranges, ZIP Codes, and feature names, which are available without cost since U.S. Government publications are required to be released into the public domain.

**In- and outhouse applications**

TIGER was extensively used within the Bureau. The database and its suite of applications software has been used to provide the geographic framework and maps required to complete the 1990 and 2000 censuses of the United States, Puerto Rico, and Island Areas, three economic censuses, numerous special censuses and census tests, several monthly household surveys, and contributed to the development of a continuous measurement system known as the American Community Survey.

However, TIGER was also used for many purposes other than the census by local/tribal governments and private industry. This can be largely attributed to the open access policy of the United States federal government. The latter has been the fuel in the explosion of GIS technology and relevant applications throughout all levels of government, academia, and much of the private sector in the United States. The public products of the TIGER database allowed the then nascent Geographic Information System-GIS industry of the United States to flourish by devoting energy to the development of powerful and innovative display and analysis tools rather than to gathering, updating, and disseminating geographic base data. Instead of competing with the private sector developers of GIS software products, the Census Bureau works actively to assure that all interested parties know what the next planned formats of the TIGER extracts will be.

---

12 [http://www.whitehouse.gov/omb/circulars_a130_a130trans4](http://www.whitehouse.gov/omb/circulars_a130_a130trans4), accessed 5 May 2011
be so that each company can prepare the tools and packages it believes to have the greatest commercial value. It is worth noticing that the Census Bureau did not need to release TIGER since it could have just put out paper maps and data. However it did and in this way it contributed to the democratization of data. TIGER was developed and procured to support and improve the Bureau's process of taking the Decennial Census. However it ended up as an innovative tool for the development of a whole industry, GIS, which was largely based in this technology in order to flourish.

II. Federal Aviation Administration: Automatic Dependent Surveillance-Broadcast (ADS-B) Program

ADS-B stands for:

- **Automatic** It's always on and requires no operator intervention.
- **Dependent** It depends on an accurate Global Navigation Satellite System (GNSS) signal or a Flight Management System (FMS) for positional data.
- **Surveillance** It provides "radar-like" surveillance services to determine the position of an aircraft.
- **Broadcast** It continuously broadcasts aircraft position and other data to any properly equipped aircraft and ground station.

ADS-B is one of the most important, underlying technologies in the FAA’s plan to transform air traffic control from the current radar-based system to a satellite-based system. ADS-B is the cornerstone for the FAA’s NextGen Program. NextGen is a wide-ranging initiative to transform the air traffic control system. It focuses on leveraging new technologies, such as satellite-based navigation, surveillance, and networking, and involves meaningful collaboration among government departments and agencies as well as companies in the aerospace and related industries. Essentially it is a technology solution that pinpoints an aircraft's location using satellite GPS navigation, and allows the aircraft to constantly broadcast its precise location and other flight data (e.g., altitude, velocity) to nearby aircraft and air traffic controllers. ADS-B will for the first time allow both pilots and controllers to see the same real-time displays of air traffic, thus improving safety and air traffic management. ADS-B is bringing the precision and reliability of satellite-based surveillance to the skies. The ADS-B Program objective is to develop a multi-segment, lifecycle managed, performance based ADS-B strategy that aligns with the Next Generation Air Transportation System (NextGen) vision and generates value for the National Airspace System (NAS) through:

- Development of a Concept of Operations for the ADS-B portfolio of applications
- Development of a life cycle management approach for each application in the portfolio
  - portfolio management for applications
  - requirements management across the applications

---

13 Marx, R.W., A TIGER Uncaged: Taking a Good United States Policy., Proc. NICCOGRAPH 92 Conference,
performance criteria management

- Establishment of a multimode infrastructure that supports a wide range of NAS users and applications
- Continuously monitoring value and adjusting ADS-B investments in the NAS

The FAA went through a multi-stage contracting process to ensure that it selected the best vendor for this project. Prior to issuing a Request For Offers (RFO), they had multiple “Industry Days.” The Industry Days allowed interested businesses to present their thoughts on the development of the ADS-B system. These presentations then directly influenced the writing of the contract requirements. Following these meetings, the FAA then requested a Screening Information Request (SIR), which is provided. The SIR allowed the serious competitors to come forward and submit a proposal. Once the SIR’s were evaluated the three vendors that submitted could learn and improve their proposals based on the feedback and submit and RFO. During the entire process, FAA remained in direct communication with the vendors and the industry. In addition, the FAA made a controversial move to have this be a services contract. This allowed a lot more flexibility in the responses that the vendors could provide. A quote from the ADS-B NAS Wide Acquisition Program Advance Notification to Industry issued in April, 2006 really makes the agency’s flexibility and openness known.

“It is believed that a performance specification will allow greater flexibility in execution of a solicitation. With a performance specification, the FAA will have an option of a "traditional" solicitation wherein offerors would present designs, manufacture, test, and deliver equipment to FAA or an option where offerors would propose their approach for satisfying the performance service requirements using their own facilities and equipment without any delivery to or ownership by FAA. The later option allows industry to utilize and maintain equipment that does not meet all the FAA imposed requirements such as wiring bend radius, physical dimensions, markings, etc. Provision of a service would be the contract deliverable, in the same manner as cell phone and cable TV providers….Consideration is being given to a performance based acquisition whereby industry would be given the opportunity to create contract pricing terms and conditions. The FAA is interested in unique approaches which allow both incentives to the contractor and penalties for non-performance. FAA is open to discussion of methodologies to reduce the overall cost of broadcast services through potential added opportunities created for broadcast services providers. The BSGS draft specification, modified as appropriate by industry comment, will also be provided as guidance and information, possibly before any formal solicitation.”

This quote represents why the contract has seemingly been successful to date. The level of communication, direct connection to management, and the allowance of business to bring their ideas to the forefront has fostered an open and innovative environment.

ADS-B uses GPS signals along with aircraft avionics to transmit the aircraft’s location to ground receivers. The ground receivers then transmit that information to controller screens and cockpit displays on aircraft equipped with ADS-B avionics. According to FAA, ADS-B will supplement and ultimately replace ground-based radar because an ADS-B-equipped aircraft can provide controllers and pilots in other aircraft with faster updates of important flight information (e.g., aircraft identification, position, altitude, direction, and speed). Specifically, ADS-B transmits position information once per second, whereas radar systems in the vicinity of airports generate
reports once every 4 to 5 seconds. Also, unlike radar, the accuracy of ADS-B does not change based on the distance between the aircraft and the sensor.

In 2007, FAA awarded a contract to ITT Corporation for $1.8 billion—if all options are exercised through 2025—to develop and deploy the ADS-B ground infrastructure and start broadcasting services. FAA plans to implement ADS-B in two segments. Segment 1 (establish ground infrastructure for five key sites) is contracted under a cost-plus incentive fee agreement in which FAA covers the cost for any additional requirements. Segment 2 (equipment needed to fully deploy ADS-B nationwide) is contracted under a fixed-price arrangement in which ITT covers the cost of deploying enough radios to meet requirements. FAA approved nearly $1.7 billion in capital costs through 2014, to support ADS-B implementation. FAA is planning to spend just over $200 million in fiscal year (FY) 2010. The total life-cycle cost through 2035 of the ADS-B effort is uncertain but estimated to be about $4.0 billion—this includes $2.3 billion in capital costs not yet formally baselined.

ADS-B has been deployed at the following key sites:

- The Gulf of Mexico. Air traffic controllers at the Houston en route center are now able to separate aircraft tracked by radar and ADS-B. This brings significant improvements in safety and efficiency since radar coverage does not extend beyond 200 miles over water.
- Louisville. The system is being used by controllers in the tower at Louisville International Airport and at the Louisville Terminal Radar Approach Control (TRACON) facility. Louisville was chosen as a key site in part because of UPS’ voluntarily participation in the program.
- Philadelphia. Controllers in the Philadelphia area now have the capability to use ADS-B to track and separate aircraft. ADS-B coverage in Philadelphia extends 60 nautical miles out from Philadelphia International Airport and approximately 10,000 feet up. It also covers the surface area and the approach corridors to the runways. Philadelphia was selected in part because UPS has equipped some of its aircraft with ADS-B and a large amount of their operations are conducted there.
- South Florida. Controllers are not yet using ADS-B to separate aircraft in that region, but general aviation aircraft equipped with ADS-B avionics now have weather and traffic information broadcast to the cockpit for free. ITT has installed 11 ground stations in the region.

**ADS-B Benefits**

ADS-B, for the first time, allows pilots to see what controllers see: other aircraft in the sky around them. Pilots are also able to see – and avoid – bad weather and terrain, and receive flight information such as temporary flight restrictions. The improvement in situational awareness for pilots greatly increases safety. In addition, the improved accuracy, integrity and reliability of satellite signals over radar means controllers will be able to safely reduce the mandatory separation between aircraft. This will increase capacity in the nation’s skies. ADS-B also provides greater coverage, since ADS-B ground stations are so much easier to place than radar. Remote areas without radar coverage, like the Gulf of Mexico and parts of Alaska, are now covered by ADS-B. ADS-B will also reduce the risk of runway incursions. Pilots and controllers
will be able to see the precise location of aircraft and properly equipped ground vehicles moving on the ground – even at night or during heavy rainfall. Finally, relying on satellite signals instead of ground-based navigation aids also means aircraft fly more directly from Point A to Point B, saving time and money while reducing fuel burn. United Parcel Service (UPS), seeing the benefits voluntarily equipped approximately 100 of its aircraft with ADS-B avionics, knowing that it will recoup its investment by saving time and money on flights to and from its Louisville hub.

Comparing the Ground Radar-Based System to the ADS-B System

In comparing the current Ground Radar-Based System to the ADS-B System, the need is quite apparent.

- **Lower Cost, Higher Accuracy, and More Frequent Updating of Information**
  ADS-B infrastructure consists of relatively simple radio stations, which are significantly cheaper to install and maintain than traditional radar that requires significant mechanical infrastructure and signal processing. ADS-B is also more accurate at identifying aircraft and determining position. The ADS-B System is updated by aircraft every second, compared to once every 12 seconds for en route radar systems. And ADS-B provides three-meter accuracy, which combines for increased operating efficiency in areas of dense traffic.

- **Full Airspace Coverage**
  ADS-B equipment can be installed in areas where it is not feasible to establish radar-based surveillance equipment. For instance, ADS-B equipment will be installed on oil platforms in the Gulf of Mexico, delivering substantial safety and efficiency benefits to air traffic flying over the area.

- **Improved Cockpit Safety**
  ADS-B equipped aircraft will be able to receive and display in the cockpit the position of all other ADS-B equipped aircraft in the area. Until all aircraft can be fully equipped, the Traffic Information Services Broadcasts (TIS-B) will provide situational awareness to ADS-B equipped aircraft by identifying radar targets of non-ADS-B equipped aircraft. The FAA's ADS-B concept also provides Flight Information Service - Broadcast (FIS-B) to provide pilots with current weather information and awareness of meteorological conditions that might impact flight.

- **Increased Airspace Capacity and Efficiency**
  ADS-B provides a vehicle for increase cockpit involvement in the air traffic control process. This may represent the most significant potential benefit of ADS-B in terms of airspace capacity and efficiency. The ability of aircraft to have a cockpit display of all surrounding traffic enables air traffic control procedures that begin to involve the participation of the cockpit crew. Several applications of this capability have been defined and are in the process of achieving operational certification. For instance, Cockpit Based Merging and Spacing can allow a pilot to lock onto a proceeding aircraft and to maintain a very precise spacing interval. This offers the ability to optimize the arrival spacing at busy terminal areas and to make maximum use of Continuous Descent Arrival (CDA) arrival procedures delivering fuel savings and reduced emissions.
### Ground radar-based system  |  ADS-B system
---|---
On the ground, dependent on human participation | On the aircraft, providing a constant flow of more accurate ID and location data
Coverage gaps exist in some areas | ADS-B ground stations can be placed anywhere (e.g., mountains, oil rigs)
Positions updated by aircraft every 12 seconds | Positions updated by aircraft every second
Costly to install and maintain | Significantly less costly to install and maintain

**Acquisition Strategy**

Performance based Service Acquisitions involve acquisition strategies, methods, and techniques that describe and communicate measurable outcomes rather than direct performance processes. It is structured around defining a service requirement in terms of performance objectives and providing contractors the latitude to determine how to meet those objectives. Further, Industry Days and one-on-one meetings can expand the range of potential solutions, change the nature of the acquisition, establish the performance-based approach, and represent the agency’s first step on the way to an “incentivized” partnership with a contractor. Both of the approaches were taken with the acquisition of ADS-B. Numerous industry days were held, and the comments provided by vendors led to changes to the scope and nature of the solicitation.

In developing the acquisition process, the FAA issued a Screening Information Request (SIR) in November 2006. The FAA evaluated vendors’ proposed solutions for developing, installing, and making operational ADS-B services for a sample service volume from Philadelphia to New York. Teams headed by ITT Corp., Lockheed Martin, and Raytheon were found to have viable solutions. The agency then issued a Request for Offer (RFO) in March 2007 that officially asked the three vendors to submit their proposals for providing ADS-B services. A team of subject-matter experts in technical, business, and cost areas evaluated and scored each proposal, based on strict evaluation criteria. Based on this extensive analysis, the FAA in August 2007 awarded the contract to the team headed by ITT, Corp because its proposal combined the best value and presented the least risk for a successful implementation.

Under the ADS-B contract, vendors will install and maintain the ground-station equipment, and the FAA will pay subscription charges to the vendor, just as the agency today buys telecommunications services from telecommunications companies. This is known as a performance-based service acquisition. This service-based acquisition is possible in part because ADS-B ground stations are small and can be deployed nearly anywhere, unlike huge radars the government owns today. From the government’s point-of-view, a performance-based service acquisition maximizes the competition and substantially reduces the costs accrued by leasing land and owning, maintaining, and upgrading equipment throughout the system’s lifecycle. It also allows vendors to use facilities and equipment they already own – such as cell phone towers and support buildings, fiber-optic networks, and operations centers – so they can piggy-back off
existing assets. As a result, actual hardware investments will be relatively small since much of the infrastructure is already in place and being used for other purposes. This speeds the deployment and reduces costs. Finally, by purchasing services instead of equipment, the FAA can easily and quickly adapt to local increases or decreases in air traffic volume that change the level of services required. Once the ADS-B infrastructure is in place, vendors will likely use the system’s capabilities to offer even more services to pilots and airlines.

**ITT & ADS-B Development**

The ITT contract requires them to provide ADS-B surveillance and broadcast services for the nation’s airspace. Under the contract, the ITT will install, own and maintain the ground infrastructure, while the FAA pays for the surveillance and broadcast services. The FAA will pay subscription charges for ADS-B broadcasts transmitted to properly equipped aircraft and air traffic control facilities. The contract was worth approximately $1.8 billion from 2007 to 2025.

Also on ITT Corporation’s team are: AT&T, Thales; WSI, Corp; Science Applications International Corporation (SAIC); PriceWaterhouseCoopers; Aerospace Engineering; Sunhillo; Comsearch; Mission Critical Solution (MCS) of Tampa; Pragmatics; Washington Consulting Group; Aviation Communications and Surveillance Systems (ACSS); NCR Corporation; and L-3 Avionics Systems and Sandia Aerospace.

---

**Acquisition: FAA Life Cycle Management Process**

![Diagram of FAA Life Cycle Management Process](image-url)

Legend:
1. Mission Need Decision
2. Investment Analysis/Readiness Decision
3. Initial Investment Decision
4. Final Investment Decision
5. In-Service Decision
6. CONOPS = Concept of Operations; ISP = Integrated Safety Plan; FPR = Final Program Requirements; RFI = Request for Information; SIR = Screening Information Request; RFO = Request for Offer

---

41
III. NASA: Constellation Space Suit System\textsuperscript{14}

Background

The National Aeronautics and Space Administration (NASA) is an executive branch agency of the United States government, responsible for the nation's civilian space program and aeronautics and aerospace research. NASA's self-described mission statement is "to reach for new heights and reveal the unknown so that what we do and learn will benefit all humankind"\textsuperscript{15}. One of the most important programs of the agency for the past few years has been the Constellation Program, designed to put a man back on the moon. Constellation, the system of rockets and hardware to replace the aging space shuttle, is supposed to put astronauts back into orbit by 2020. The stated goals of the program are to gain significant experience in operating away from Earth's environment, develop technologies needed for opening the space frontier, and conduct fundamental science\textsuperscript{16}. This goal will be achieved by a series of achievements such as the development of the Crew Exploration Vehicle (Orion), the Return to the Moon, the Extension of the human presence across the solar system and beyond, the development and support of innovative technologies, knowledge and infrastructures and the completion of the International Space Station\textsuperscript{17}. The International Space Station is an unprecedented achievement in global human endeavors to conceive, plan, build, operate, and utilize a research platform in space. With the assembly of the space station at its completion and the support of a full-time crew of six, a new era of utilization for research is beginning.

Constellation Program missions to the International Space Station

The initial Constellation Program missions to the International Space Station (ISS) are planned to begin as early as 2012, but no later than 2014. The elements required for this phase include, among others, the Crew Exploration Vehicle (CEV), Crew Launch Vehicle (CLV), necessary ground systems and a space suit system providing at least launch, entry and abort (LEA) and zero-gravity extravehicular activity (EVA) capability. Lunar sortie missions are planned to begin as early as 2015, but no later than 2018. The additional elements required for the lunar sortie phase include the Lunar Surface Access Module (LSAM) and any additional space suit system elements required to support surface EVA. The Constellation program space suit is required to have the following capabilities: 1) Crew protection and survivability during LEA scenarios (including spacecraft depressurization, egress mobility and water survival), 2) Zero-gravity EVA for in-space EVA (including contingency crew transfer between vehicles), 3) Surface EVA capability for lunar sortie missions (less than two weeks), 4) Surface EVA capability for lunar outpost missions (up to six months), and 5) EVA capability for Mars missions.

More analytically, the new space suit will consist of two configurations. The first is similar to the current space shuttle escape suit, and it is designed for launch, reentry, and emergency operations in zero gravity and on Earth. It is soft and allows for mobility in the event of pressure loss or in case crew members need to abort. The second configuration of the Constellation space suit,

\textsuperscript{14} At this point the state of progress of the program Constellation is unclear.
\textsuperscript{15} http://www.nasa.gov/about/highlights/what_does_nasa_do.html, accessed 8 May 2011
\textsuperscript{16} http://www.nasa.gov/pdf/163092main_constellation_program_overview.pdf, accessed 8 May 2011
\textsuperscript{17} http://www.nasa.gov/pdf/163092main_constellation_program_overview.pdf, accessed 8 May 2011
which will be used for lunar excursions will use the same arms, legs, boots, and helmet. These will be able to snap onto a new reinforced torso equipped with life support, electronics, and communication systems. Astronauts will also put on an outer garment to protect them from the harsh lunar atmosphere, including micrometeorites.

**The Oceaneering CSSS program**

To this goal, NASA issued a Request for Proposal-RFP (Solicitation Number: NNJ06161022R) for the design, development, certification, production, and sustaining engineering of a space suit system to meet the needs of the Constellation Program. Industry was invited to submit a response to this inquiry to assist NASA in the planning for the Constellation Space Suit System (CSSS) acquisition development. The design of the suit was announced by NASA on June 11, 2008, and it will be manufactured by Houston, Texas-based Oceaneering International, the first company other than the David Clark Company, Hamilton Sundstrand, and ILC Dover (and, before 1964, B.F. Goodrich) to produce life-support hardware, as a prime contractor, for in-flight use. Oceaneering was one of two teams competing for the contract. The other was a joint effort by Hamilton Sunstrand and ILC Dover. The subcontractors to Oceaneering are Air-Lock Inc. of Milford, Conn., David Clark Co. of Worcester, Mass., Cimarron Software Services Inc. of Houston, Harris Corporation of Palm Bay, Fla., Honeywell International Inc. of Glendale, Ariz., Paragon Space Development Corp. of Tucson, Ariz., and United Space Alliance of Houston.

The Oceaneering CSSS program office is located at Oceaneering Space Systems' facilities in Houston, Texas immediately adjacent to NASA's Johnson Space Center and Oceaneering's CSSS Program Manager is former NASA astronaut Jim Buchli. The company has a long history of supporting NASA in training astronauts for extravehicular activity, and designing, developing, testing, producing, and certifying astronaut equipment, robotic systems, and thermal protection systems for NASA, the Department of Defense, and commercial applications. Of interest, Oceaneering is a global provider of engineered services and products primarily to the offshore oil and gas industry, with a focus on deepwater applications. Through the use of its applied technology expertise, Oceaneering also serves the defense and aerospace industries and is an example of how technology transcends disciplinary and market barriers.

**Characteristics of the procurement plan**

The cost-plus-award-fee spacesuit contract includes a basic performance period from June 2008 to September 2014 that has a value of $183.8 million. During the performance period, Oceaneering and its subcontractors will conduct design, development, test, and evaluation work culminating in the manufacture, assembly, and first flight of the suit components needed for astronauts aboard the Orion crew exploration vehicle. The basic contract also includes initial work on the suit design needed for the lunar surface. Two contract options may be awarded in the future as part of this contract. Option 1 covers completion of design, development, test and evaluation for the moon surface suit components. Option 1 would begin in October 2010 and run

---

through September 2018, under a cost-plus-award fee structure with a total value of $302.1 million. Option 2 provides for the Orion suit production, processing and sustaining engineering under a cost-plus-award fee or a firm-fixed-price, indefinite-delivery, indefinite-quantity contract structure with a maximum value of $260 million depending on hardware requirements. Option 2 would begin at the end of the basic performance period in October 2014, and would continue through September 2018.22

The recent NASA contract for constellation spacesuit for the moon is an example of a cost plus contracts, an interesting aspect of this procurement process whereby the contractor is paid a percent in addition to labor and materials cost. This contract requires an agency to pay the contractor’s expenses for the execution of work plus a profit previously agreed upon. It means that an agency has to apply a specific percentage to the actual labor and materials cost to be paid to the contractor. Consequently, although more flexible in the project execution, some percentage of risk on the project is laid on the agency when a cost plus contract is used. Furthermore, such a contract requires the agency’s constant monitoring of contractor’s spending in order to ensure that the funding is being spent adequately and appropriately. Cost plus contracts are usually used when it is difficult to estimate the final cost and timing of the project, in particular in construction, research and development fields. Obviously, NASA chose this type of contracting because for such a long-term development project it is rather difficult to estimate all the potential expenses. On the other hand, however, they will have to constantly maintain detailed records on all the cost and materials spent by the contractor. As a result, such contracts require from the agency much attention, constant and close supervision. Besides, the agency is exposed to a number of risks, and, consequently, cannot adequately plan its budgeting and strategic development. However, the fixed price contract provides both the contractor (Oceaneering International,) and the buyer (NASA) with clear and definite goals to be reached by the specified deadlines23.

IV. Department of Energy: Creating an Offshore Wind Energy Industry in the United States

Introduction

As the imperatives of combating climate change and securing energy supply are becoming stronger, the United States is deliberating an energy policy that will have a powerful impact on the nation’s energy and economic health for decades to come. Offshore wind energy can help the country reduce its greenhouse gas emissions, diversify its energy supply, provide cost-competitive electricity to key coastal regions, and stimulate economic revitalization of key sectors of the economy. It is in this context that in his 2011 State of The Union Address, President Obama announced the goal of generating 80 percent of the Nation’s electricity from clean energy sources, including wind, by 2035. In order to realize this goal, the Department of Energy (DOE) will pursue a scenario of 54 gigawatts (GW) of deployed offshore wind generating capacity by 2030, at a cost of energy of 7 cents per kilowatt-hour (kWh), with an

interim target of 10 GW of capacity deployed by 2020, at a cost of energy of 10 cents per kWh. The scenario is largely based on the existence of vast wind resources in the vicinity of the highly populated coastal areas in the U.S. which consume about 78 percent of the nation’s electricity\textsuperscript{24}.  

In this setting the role of the federal government is to provide a stable and predictable technological and market framework and to promote and coordinate relevant public and private initiatives. The “National Offshore Wind Strategy: Creating an Offshore Wind Energy Industry in the United States” was prepared by the U.S. Department of Energy’s (DOE) Office of Energy Efficiency and Renewable Energy (EERE) Wind and Water Power Program to expand its efforts on the Offshore Wind Innovation and Demonstration (OSWinD) Initiative by outlining the actions it will pursue to support the development of a world-class offshore wind industry in the United States\textsuperscript{25}.  

On the other hand, as the agency with primary jurisdiction over reviewing and approving offshore wind projects in federal waters, it is the Department of the Interior (DOI) that develops regulations to review anticipated offshore wind projects along with siting, leasing, and construction of such new projects. Over the past two years, DOI has developed a regulatory framework to review proposed offshore wind projects in federal waters and recently launched the Smart from the Start initiative to facilitate siting, leasing, and construction of new projects\textsuperscript{26}. The National Offshore Wind Strategy incorporates elements of both the OSWinD and Smart initiatives and illustrates the commitment of DOE and DOI to work together to spur the rapid and responsible development of offshore wind energy.  

**Key challenges**  
Despite its benefits the development of offshore wind energy holds many uncertainties and several barriers are in the way of a fully operating context. The relevant barriers and risks that call for action range from, to name a few, high costs of offshore wind facilities and market issues to technical and permitting challenges.  

High capital costs and cost of energy are largely due to technology issues that require research and development to achieve competitive market pricing in the long term. Substantial lowering of the energy cost can also be achieved through reduction of financing costs, increase of the amount of generated energy and by demonstration of durable wind technologies that will reduced the perceived risk on the part of potential investors. The technical and infrastructure challenges mainly pertain to the lack of resource characterization, the need for additional grid infrastructure and the necessity of legislation review that will allow for the implementation of new technology. Finally, permitting challenges need to be overcome. The installation, operation and maintenance of an offshore wind energy production unit spans the jurisdiction of a multitude of regulatory bodies that pose a unique set of permitting challenges.

\textsuperscript{24}http://www.aero.psu.edu/images/0411_Technology.pdf, accessed 29 April 2011.  
\textsuperscript{25}http://www1.eere.energy.gov/windandhydro/pdfs/national_offshore_wind_strategy.pdf, accessed 29 April 2011  
**OSWInD Strategy**

The Strategy considers two critical objectives, namely the need for cost and deployment timelines reduction. To meet these objectives the OSWInD initiative will undertake a set of seven major activities: Computational Tools and Test Data, Innovative Turbines, Marine Systems Engineering, Siting and Permitting, Complementary Infrastructure, Resource Planning, and Demonstration Projects. These activities that address the spectrum of barriers inherent to the establishment of offshore wind energy production from null, are further specified into research areas, details, and stages and are administered through three focus areas: Technology Development, Market Barrier Removal, and Advanced Technology Demonstration.

The Strategy lays out a beam of measures for overcoming those challenges. DOE will undertake these activities through its Offshore Wind Innovation and Demonstration (OSWInD) Initiative, a national effort to develop and deploy offshore wind technology. As mentioned above, two critical aspects determine the success of this initiative and U.S. offshore wind as a whole and must be taken into consideration. The first is the cost of offshore wind energy which needs to be low in order to ensure competitiveness with alternative electrical generation sources. DOE will help reduce the cost of offshore wind energy through (1) technology development to reduce capital costs, including the development of larger-scale systems with greater generating capacities; (2) applied research and development to decrease installation, operations, and maintenance costs; (3) technical research to decrease financing costs; and (4) turbine innovation to increase energy capture, including the development of larger rotors, longer blades, and taller towers, as well as improved reliability and availability to reduce downtime. The second critical objective is the reduction of deployment timelines and uncertainties limiting U.S. offshore wind project development. DOE will help reduce the offshore wind deployment timeline through three primary activities: (1) resource planning, which will address wind resource characterization and other data required for coastal and marine spatial planning; (2) siting and permitting, which will address policy and economic analysis, radar interference, regulatory processes, environmental risks, public acceptance, interagency dialogue concerns and risk management; and (3) complementary infrastructure, which will address domestic manufacturing and supply chain development, transmission and interconnection planning, and specialized vessels and other installation, operations and maintenance technology.

**OSWInD Implementation**

The OSWInD initiative along with funding opportunities addresses these inherently critical aspects through three main pillars: technology development, market barrier removal, and advanced technology demonstration. Each pillar is implemented through certain activities materialized by certain research areas that call for specific predetermined deliverables.

*Technology Development*

This focus area is further divided into three main highly integrated activities such that results in one area will be used as inputs to another area. Activities i.e. computational tools and test data, innovative turbine concepts and marine systems engineering will focus on improvements to models, design tools, components, turbines, and balance-of-system components that will lead to a lower cost of energy, reduction in technological risk, and increased access to wind resources. The main objective for all will be to provide better access to offshore wind resources at a
reduced technological risk. An emphasis is given to the further development of design tools and wind turbine system components including, among others, innovative turbine concepts, advanced drive concepts, controls and power electronics, support structures, and the total balance-of-system.

*Market Barrier Removal*

This area tackles the critical aspect of deployment timeline and aims in increasing the relevant efficiency. The three main categories taken into consideration are siting and permitting, complementary infrastructure, and energy resource planning. Market analysis, public acceptance, environmental risks, and the impact on current marine operations play an integral part of this focus area. As for the infrastructure the development of a suitable manufacturing and supply chain combined with strategies for transmission and interconnection are being sought. With the aim of addressing potential stakeholders and program assets the energy resource characterization will engage industry experts in an interagency working group.

*Advanced Technology Demonstration*

The primary objective of this effort is to support the installation of offshore wind turbines in U.S. waters in the most rapid and responsible manner possible. A successful deployment of advanced technology demonstration projects will help to reduce uncertainties in offshore operating conditions and to refine existing and innovative technology. Examples of potential demonstration projects are a smaller grid-connected demonstration project that serves as a research center for selected technical challenges associated with local conditions, and a large grid-connected demonstration project that allows for the installation and testing of multiple systems from multiple manufacturers.

The recent funding opportunity announcement requires responses from academia, national laboratories, and industries that present novel, creative, multidisciplinary, and intriguing ideas.

*A representative case of OSWInD Implementation: Innovative Turbines*

As mentioned earlier, each activity addresses an aspect of the spectrum of barriers inherent to the establishment of offshore wind energy production and is further specified into research areas, details, and stages. Among the most important ones is the development of innovative turbines.

**Activity 1.2: Innovative Turbines**

DOE plans to form partnerships with research consortia, including industry, to identify, model, and eventually demonstrate candidate system configurations with high potential to impact cost of energy. More analytically, in order to lower overall project cost of energy, innovative integrated turbine configurations, encompassing rotor, drivetrain, tower, controls and foundations, are needed to reduce system weight relative to rated capacity, simplify installation processes, dramatically reduce maintenance requirements, improve reliability, increase energy capture, and derive benefits from economies of scale in general. To materialize this goal DOE has recognized four research areas that deal with specific problems.

**Research Area 1.2.1: New Turbine Concepts**
It is generally recognized that, in order to generate cost-competitive electricity, larger turbines are needed to overcome the added cost of foundations and other non-turbine capital costs associated with offshore wind turbines. This research area will focus on large, cost-effective turbine concept studies and studies on the development of advanced rotors. The deliverables will be turbine concepts with full cost analysis, demonstrated engineering feasibility, and tradeoffs for hardware development and new materials, manufacturing methods and design concepts to enable next-generation rotor development respectively. Research in those areas is anticipated to result in larger machines needed to lower balance of station costs that dominate offshore project economics and innovations in materials, manufacturing and design lead to load and weight reduction enabling higher energy capture and larger machines.

Research Area 1.2.2: Advanced Drive Concepts

The activities within this research area aim to evaluate and develop innovative turbine drivetrains with potential for lower cost of energy and develop a reliability framework and O&M Priorities. The deliverables will be innovative turbine drivetrains demonstrated to improve reliability, lower cost, reduce weight, and increase energy capture and reliability characterization and analysis reporting. The impact of the relevant research is anticipated to include innovations in the market that increase reliability, lower costs, and increase energy capture and the creation of a database that gathers/provides information targeted at improving reliability and asset management.

Research Area 1.2.3: Controls and Power Electronics

This research area mainly deals with the evaluation and development of condition-based monitoring systems for offshore systems and the evaluation and development of advanced control systems for offshore wind turbines. The deliverables will be a comprehensive suite of sensors and robust algorithms that detect impending problems before they occur and control systems that increase hurricane survivability, reduce operational loads, and provide sufficient damping for floating platforms respectively. The anticipated impact of the relevant research outcomes is improved availability and reliability with lower operating costs and improved energy capture along with increased survivability, energy capture and successful operation of floating platforms.

V. National Oceanic and Atmospheric Administration (NOAA)

Introduction

The National Oceanic and Atmospheric Administration (NOAA) is a scientific agency within the United States Department of Commerce focused on the conditions of the oceans and the atmosphere. NOAA's primary mission is to warn of dangerous weather, chart seas and skies, guide the use and protection of ocean and coastal resources, and conduct research to improve understanding and stewardship of the environment. The agency conducts an end-to-end sequence of activities, beginning with scientific discovery and resulting in a number of critical environmental services and products relating to: monitoring and observing Earth systems with instruments and data collection networks, understanding and describing Earth systems through research and analysis of that data, assessing and predicting the changes of these systems over
time, engaging, advising, and informing the public and partner organizations with important information and managing resources for the betterment of society, economy and environment.

NOAA and development of new technologies

NOAA promotes the introduction of new technologies that will enable it to describe, understand, and predict the environment. Core technologies include:

- Biodegradable sensors in target environments that are cheap enough to simply be replaced rather than maintained
- Mobile sensor platforms (e.g., unmanned aerial vehicles and remotely operated undersea vehicles) to monitor and observe the land, the atmosphere, and the ocean surface, depths, and floor
- Information technology to advance model-based analysis techniques to describe, understand, and predict the interactions of all parts of the environment at increasingly finer resolution and
- Telecommunications that will have the capacity to link modeling and ecological information centers seamlessly and effortlessly thus providing users with the capability to “reach back” to powerful high performance computers, taking advantage of state-of-the-art modeling and forecasting, to meet their own, individual needs.

Examples of cases

The following cases are examples of technologies that were developed or are planned to be developed as part of NOAA's need for increased accuracy, reliability and speed. It is with regards to these needs that agencies with missions of research such as NOAA usually come up with new, innovative technologies and technological systems.

Remotely Operated Vehicles (ROV)

In the last 50 years technology has advanced to the point that humans can examine the oceans in systematic, scientific, and, most importantly, noninvasive ways. The National Ocean Service (NOS) line office is focused on ensuring that ocean and coastal areas are safe, healthy, and productive. Remotely Operated Vehicles (ROVs) are among the innovative technologies that make today's explorations possible such as the numerous vessels, submersibles, diving technologies and observation tools that enable researchers to examine, record, and analyze the oceans.

A ROV is an unoccupied, highly maneuverable underwater, tethered robot usually equipped with a video camera and lights. It is linked to the ship by an umbilical cable, a group of cables that carry electrical power, video and data signals back and forth between the operator and the vehicle. High power applications will often use hydraulics in addition to electrical cabling. ROVs are highly customized and their equipment may include a still camera, a manipulator or cutting arm, water samplers, and instruments such as sonars and magnetometers that measure water clarity, light penetration, temperature and other parameters.

28 Interview with Mitch Ross, Director, Acquisition and Grants Office, NOAA, March 28, 2011.
First developed in the 1960s with funding from the US Navy, most of the early ROV technology development resulted into what was then named a "Cable-Controlled Underwater Recovery Vehicle" (CURV). This created the capability to perform deep-sea rescue operation and recover objects from the ocean floor. Building on this technology base, the offshore oil & gas industry created the work class ROVs to assist in the development of offshore oil fields. Since then, technological development in the ROV industry has accelerated and today ROVs perform numerous tasks in many fields. Their tasks range from simple inspection of subsea structures, pipeline and platforms to connecting pipelines and placing underwater manifolds. They are used extensively both in the initial construction of a sub-sea development and the subsequent repair and maintenance.

ROVs represent an example of a technology that was developed for a purpose and served many others and through its R&D funding, NOAA has largely contributed to this direction. While it is true that the oil & gas industry uses the majority of ROVs, other applications include salvage, science and military. ROVs are often kept aboard vessels mounting submersible operations for several reasons. ROVs also support exploration and science objectives. In case a submersible cannot be used because of weather or maintenance problems, the ROV often can take its place. Lastly but not less importantly, the military uses ROV for tasks such as mine clearing and inspection29.

**High Performance Computing**

Telecommunications and information technology are core technological competences of NOAA. The Office of the Chief Information Officer (OCIO) is responsible for ensuring that NOAA's programs make full and appropriate use of information technology and oversees the expenditure of approximately $600 million each year in information technology (IT) spending such as hardware, software, services, networking, and telecommunications30. As a huge buyer in high performance computing, NOAA has established with its NAO 216-110 Order a policy for managing high performance computing resources as a corporate asset in support of its mission. The policy states that High Performance Computing (HPC) will be managed by the NOAA Environmental Modeling Program (EMP) for the benefit of NOAA as a whole31. HPC uses supercomputers and computer clusters to solve advanced computation problems. Computer systems approaching the teraflops-region are counted as HPC-computers.

The objective of use of HPC is to enable the agency to disseminate its vast holdings of real-time and historical information to users more completely, in a more usable form, and in a much more timely manner via advanced networking and to enhance NOAA's scientific productivity through the use of advanced collaboration and model analysis tools, enabling faster, more effective communications among researchers, and improved analysis, diagnosis and visualization of model output. To meet this demand, NOAA scientists require leadership-class, high performance computing (HPC) systems with petaflops - scale capabilities. NOAA currently has dozens of major models and hundreds of variants of models under development that support the full range of forecasting challenges that are maintained in the operational phase, producing millions of informational products daily for public use as well as for special needs, such as emergency

31 NAO 216-110 Eff: 5/19/06; Iss: 5/26/06
management. On the other hand, new high performance computing hardware architectures require scientific applications to run across multiple processors, rather than a single processor, to achieve desired performance. In order to accommodate this new large-scale supercomputing approach to modeling, NOAA has determined that it requires a new, more flexible HPC architecture. This target architecture must span a vast array of technical and product delivery requirements to meet the needs of millions of diverse stakeholders, including NOAA scientists, academic researchers, private sector planners, Federal partners, and the general public, particularly when life and property are threatened. In the case of NOAA, contractors are asked to push the envelope and give the most innovative solutions. Manufacturers are provided with a specific set of requirements that will allow the development of High Performance Computing systems that will accommodate the specific demands of NOAA.

Moving from Doppler Radar to Dual Polarization Radars

NOAA’s National Weather Service relies daily on radar to detect, locate and measure precipitation inside clouds. Radar technology designed to detect and locate hostile aircraft and missiles in World War II serves as the basis for today’s advanced weather radar systems. Radar is an object-detection system which uses electromagnetic waves to determine the range, altitude, direction, or speed of both moving and fixed objects such as aircraft, ships, spacecraft, guided missiles, motor vehicles, weather formations, and terrain. Due to its ability to provide information regarding the position of a variety of objects ranging from aircrafts to rain droplets can used in many different fields where the need for such positioning is crucial. Examples are aviation radars, marine radars and even vessel traffic service radar systems whereby radars are used to monitor and regulate ship movements in busy waters and to monitor vehicle speeds on the roads.

Meteorologists use radar to monitor precipitation. It has become the primary tool for short-term weather forecasting and to watch for severe weather such as thunderstorms, tornadoes, winter storms, precipitation types, etc. The WSR-88D Doppler weather radar system was developed by the NWS during the mid 1980s and fully deployed by the early 1990s. Doppler radars have the added capability of being able to measure a frequency shift that is introduced into the reflected signal by the motion of the cloud and precipitation particles. This frequency shift is then used to determine wind speed. There are 158 such radar sites in the United States and selected overseas locations. The WSR-88D Doppler weather radar provides high resolution data and the ability to detect intra-cloud motions and has been the cornerstone of NWS severe weather warning operations. Data gathered by radar and related systems are processed by meteorologists using an advanced information processing, display, and telecommunications system called AWIPS.

By the end of 2012, the entire fleet of WSR-88Ds (Weather Surveillance Radar -1998 Doppler) is scheduled for a major software and hardware upgrade. This upgrade, known as dual-polarization technology, will greatly enhance the radars by providing the ability to collect data on the horizontal and vertical properties of weather (e.g., rain, hail) and non-weather (e.g., insect, ground clutter) targets. Dual-polarization capabilities were added to the Cimarron Doppler radar in time for the 1985 spring storm season. Scientists had learned that when pulses were

---

alternately polarized vertically and horizontally the return signal provided a clearer indication of cloud and precipitation particle size, shape and ice density-they could determine if the targets were round like hailstones or somewhat flattened like raindrops. This information had great potential to improve severe weather warnings\textsuperscript{34}. Dual-pol provides the NWS with three new and valuable products, namely differential reflectivity, specific differential type which allows for better prognosis of the impacts of light and intense rain and the correlation coefficient (cc) which allows for the detection of wet or dry snow, large hail and even biological targets. This technology has various other uses beyond NWS. For instance, one of NOAA’s developments of radar technology is the mobile X-band dual-polarization Doppler radar (Hydro-Radar) which enables to study storm dynamics, boundary layer turbulence and ocean-surface characteristics. A UC Santa Cruz scientist, working with meteorologists at the University of Oklahoma, is reported to use mobile storm-chasing radars primarily developed for NWS to follow swarms of bats as they emerge from their caves each night to forage on insects. Scientist use data from 156 fixed NEXRAD weather radars around the country to produce images of bats who appear as distinct "blooms" of radar reflectivity and give scientists clues to their behavior, providing at the same time a fine example of a technology that was developed for a scope and expanded to other fields.

\textsuperscript{34} http://www.magazine.noaa.gov/stories/mag151.html, accessed 14 May 2011.
REFERENCES


[This is a partial list of literature used in this report. Most importantly, it does not include regulations for which we have provided a link and source in the main body of the report (Part I)]
ANNEX A

Executive Orders, OMB Circulars and Memorandums

1) Executive Order 13419 on National Aeronautics Research and Development
2) Executive Order 13423 on Federal Leadership in Environmental, Energy and Economic Performance
3) Executive Order 13514 on Strengthening Federal Environmental, Energy and Transportation Management
4) OMB Memo dated July 19, 2010 on “Improving the accessibility of government information” provides guidance and instructions to Chief Acquisition Officers of federal agencies to make sure that all new technologies applied and used in federal agencies are accessible to persons with disabilities. The memo encourages the agency to work with contractors to develop solutions that will meet the requirements of Section 508 of the Rehabilitation Act of 1973. The memo also asks GSA to provide guidance on any new technologies being used and how Sec. 508 can be met through innovative solutions.
5) The OMB and OFPP issued three memos, “Survey on FY2009 Green Purchasing Requirements”, “FY2008 Reporting on Green Purchasing Requirements”, and “FY 2007 Reporting on Implementation of the Resource Conservation and Recovery Act, Section 6002, the Farm Security and Rural Investment Act, Section 9002, and Other Environmental Purchasing Requirements” in the last five years. All these memos reflect and focus on the government’s focus and dedication towards the acquisition of environmentally friendly solutions by federal agencies.
ANNEX B

List of Contacted Individuals for Interviews

By late March we had secured interviews by:

1. Patrick M. Ferraro [written response]
   U.S. Department of Energy
   Director of the Office of Headquarters Procurement Services

2. Vivek Kumar
   U.S. International Trade Commission
   Chief of Procurement

3. Matthew Blum
   Office of Management & Budget
   Chair of the Interagency Acquisitions Working Group for the Chief Acquisition Officer's Council (CAOC)

4. Barry Berkowitz
   Department of Commerce
   Director of the Office of Acquisition Management

5. Mitch Ross
   Director of the Acquisition and Grants Office
   NOAA

Our request did not culminate to an interview with the following individuals. The reasons varied from flat out denial to large delays and running out of time and resources for this study:

1. Debra Sonderman
   Department of the Interior
   Co-Chair of the Acquisition Committee for E-Government Working Group for the Chief Acquisition Officer's Council (CAOC)

2. Joanie Newhart & Dan Gordon
   Associate Administrator and Administrator
   OFPP
   The White House
3. Cecelia Royster  
   Division Chief  
   Acquisition Management Division  
   NIST

4. Mike Palensky  
   Chief  
   Acquisition Division  
   U.S. Census Bureau

5. Bill McNally  
   Assistant Administrator for Procurement  
   NASA

6. Alan Schoenberg  
   United States Department of Health and Human Services  
   Office of Acquisition Policy Director

7. Joseph Waddell  
   Senior Procurement Executive  
   National Nuclear Security Administration
ANNEX C

Invitation Letter

December 10, 2010

XXXX

Dear Mr. XXXX:

The research team of Professor of Nicholas Vonortas, Director of the Center for International Science and Technology Policy (CISTP) at The George Washington University is conducting a research study aiming to better understand U.S. public sector procurement practices relating to innovation. It has been recommended to our team that we initially speak with you, in an informal conversation, to gain a broader perspective on this topic. Your role as the Chief of Staff for the Defense Acquisition University will provide invaluable insight that will progress this project.

This research study is on federal procurement practices, aiming to identify different procedures used, whether formally or informally, to promote innovation and innovative practices. The focus will be on the civilian sectors of health care, energy and environment, and infrastructure investments. In the examined cases of innovative public procurement, the study will try to describe incentive mechanisms, cost sharing, risk management, intellectual property protection, methods of proposal evaluation, and possible regulatory changes needed to enable the practice.

We sincerely hope to speak with you regarding this very important topic. Please let us know dates and times that work for your schedule and we can work around you.

Please let us know if you have any questions. For additional information on the Center please visit http://www.gwu.edu/~cistp. I look forward to hearing from you soon.

Sincerely,

Nicholas Vonortas  
Director, CISTP  
Professor of Economics & International Affairs

Debbie Mayer  
Research Associate, CISTP
ANNEX D

Interview Questionnaire

Federal Agency Interview Questions

**Proposed thesis:** Federal agencies are bound by the Federal Acquisition Regulation (FAR) which provides procedural rules regarding the procurement process. Many federal agencies slightly adapt FAR to their own specific needs. Other important documents include the Office of Management and Budget (OMB) Circulars and Memorandums issued from time to time as instructions to federal agencies for promoting economy, effectiveness and efficiency. The substantive policies are mostly left to the discretion of each acquiring agency, which set the specifications and the evaluating criteria per procurement. The result is important differences among agencies and bureaus in promoting innovative solutions through their procurement practices. Agencies encourage innovation by their suppliers to the extent that this helps achieve their missions.

**Interview Questions:**

I. **Overview**
   a. Briefly describe how procurement works in your agency (i.e. offices, leadership, publications, etc.)
   b. To what extent does the central procurement office play a guiding hand in the procurement practices for the other offices in the agency?
   c. From FAR to your office, what if any, are differences in the agency and then to the different departments?

II. **Innovations within the Agency**
   a. Does your office have a specific plan to promote innovative practices?
   b. Does your office encourage off-the-shelf products or are you looking for new solutions? How do your proposals and evaluation metrics tie to these questions?
   c. To what extent are innovative practices, processes, or products discussed in the context of procurement?

III. **Example Innovations**
   a. Can you cite any specific examples within your agency that have lead to innovative products or processes.
   b. Why did the agency choose to fund the innovation?

IV. **Summary**
   a. Do you agree with the above thesis?
   b. Do you have suggestions for other individuals inside the agency that we should talk to?