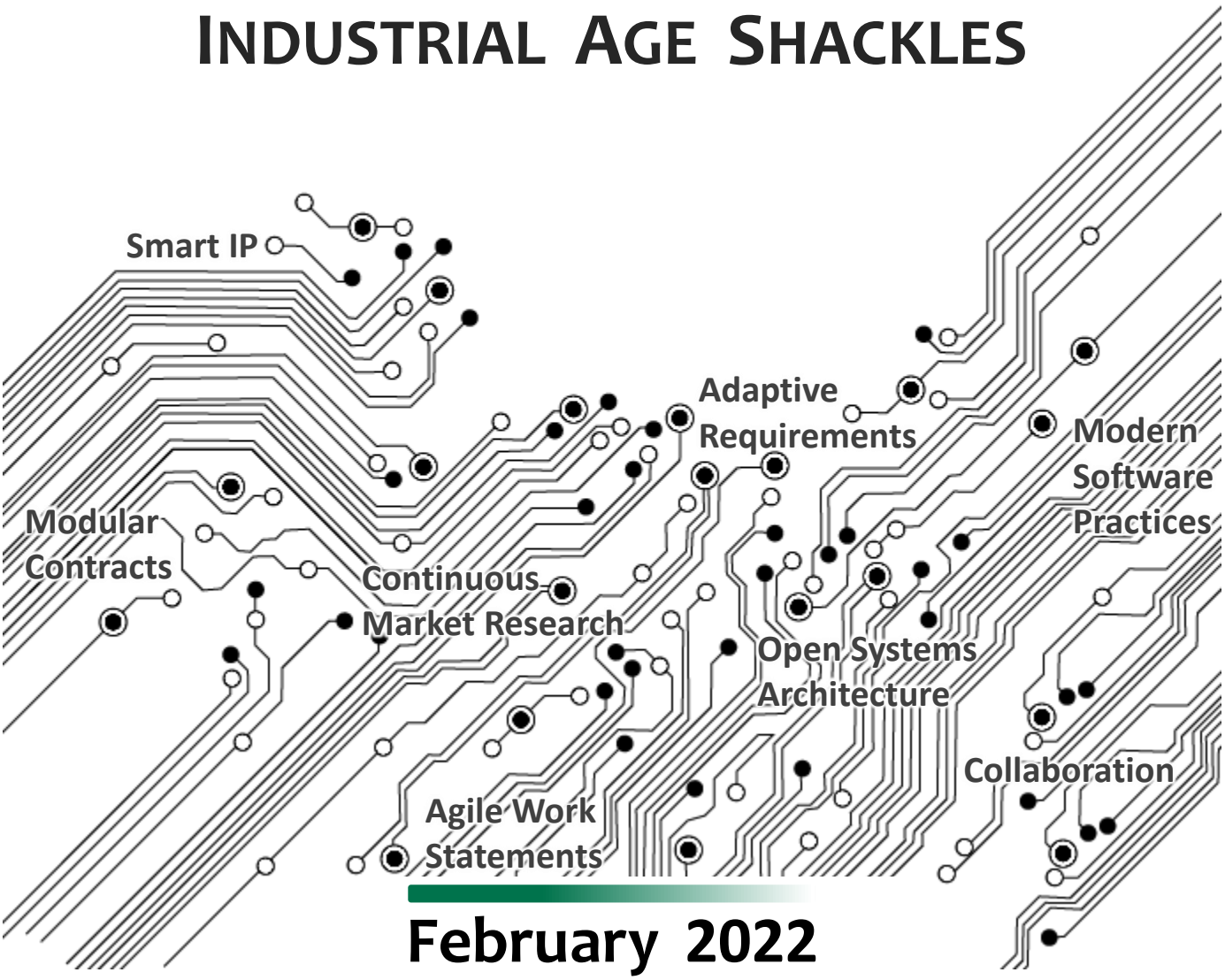
Center for
Government Contracting
School of Business

GEORGE MASON UNIVERSITY

Acquisition Next

A Playbook to Break Industrial Age Shackles



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CONTENTS

About This Publication:

This study was performed by the **Center for Government Contracting at George Mason University** in collaboration with the acquisition community in government and industry. It is intended to help government officials design and manage acquisition approaches for software intensive systems that can **break the iron triangle** by simultaneously reducing cost, reducing schedule, and increasing performance. This study has been facilitated by donations in support of defense acquisition research from Anduril, BMNT Inc., The Common Mission Project, Improbable, Scale, Balius Partners, and GoTenna.

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Executive Summary

Defense acquisition in the 21st century is still driven by policies and practices devised in the 1960s, optimized for the assembly lines of the industrial age. Meanwhile, the broader economic system has entered the digital age. Modern engineering and business practices have dramatically accelerated product development cycle times.

For the Department of Defense to keep pace, approaches based on linearity and prediction must be replaced with modularity and iteration. The Center for Government Contracting looked for this approach in real-world programs. Interviews with more than 75 professionals from a variety of backgrounds gave evidence that a paradigm shift is already underway. They helped identify the recommendations that form the foundations of this playbook.

To ensure overmatch against strategic adversaries like Russia and China, the defense acquisition system does not need a new set of reforms but rather a change in mindset. We call this change in mindset and approach **Acquisition *Next***.

- Acquisition Next translates buzzwords into business practices that people can use
- Acquisition Next accelerates capability delivery and technology adoption
- Acquisition Next enables a highly composable and networked joint force design

This playbook suggests a way to implement the Acquisition Next mindset. It distills our research into six plays. The first three apply at the total program level and to all system types. They enable the modularity and iteration necessary for the second three plays which are suited to contracts with software intensive content.

Defense acquisition leaders and professionals at all levels can use the Acquisition Next approach to innovate, iterate, scale, and *field* effective military capabilities for United States forces. Many of these practices are already being used in select programs today, but widespread adoption will help drive culture change across the acquisition community.

Program Level Plays

#1. Requirements

- **Problem:** Requirements are fixed ahead of market research and experimentation, leading to the overly complex contracts, neglect of new tech insertion, and fielding of obsolescent systems
- **Recommendation:** Focus on short statements of outcomes to increase flexibility in solution design and allow for requirements iteration over time
- **Success:** Requirements stay aligned with technical progress and user feedback is enabled by an open channel with stakeholders

#2. Market Research

- **Problem:** Market research currently responds to consolidated requirements that were not informed about the technological state of the art, and thus are biased toward legacy solutions
- **Recommendation:** Develop an organizational capability for continuously engaging with industry to identify technologies and vendors that can increase program value
- **Success:** The program is continually scanning the market for vendors as appropriate

#3. Master the Baseline

- **Problem:** The program proceeds according to one schedule even if different elements of the architecture or tech stack have different development cycle times
- **Recommendation:** Determine which system elements are technically separable and pursue traditional contracting approaches for technologies with slower cycle times and modular contracts for faster moving applications
- **Success:** The program is not being built full-stack in a single contract award and new capabilities are released at differing speeds

Software Intensive Plays

#4. Agile Work Statements

- **Problem:** Technical direction memorialized in a contract based on a rigid Statement of Work restrains flexibility when assumptions prove false
- **Recommendation:** Separate technical direction from contract requirements and use a living roadmap adjusted to the product backlog and user feedback
- **Success:** Contractors held accountable for delivery and integration through a disciplined process

#5. Modular Contracts

- **Problem:** Numerous layers of contract incentives and management controls, designed for major hardware efforts, create high transaction costs to modular contracting
- **Recommendation:** On-board with broad and flexible solicitations, transition to multiple award contract vehicles with recurring task orders and streamlined procedures
- **Success:** Outcomes from one phase provides inputs to the next, and contractors do not feel like they are in proposal-mode all the time

#6. Intellectual Property

- **Problem:** Open architecture approaches can paradoxically turn programs into "big bang" efforts with long lists of directed standards, asking for data and license rights to virtually everything
- **Recommendation:** Rather than focus on specific standards, influence a microservices architecture with rights to interfaces and operational data
- **Success:** Vendors can be onboarded quickly if needed, particularly at the application and data layers, and keep IP to their "black boxes"

The Path to Acquisition Next

Government programs can become leaders in innovation again. The plays we outline, for instance, do not require *any* changes in legislative authorities or regulations. All that is required is top-cover from leadership and support up and down the chain of command.*

Changing the culture of acquisition will take more than playbooks, templates, and good intentions. It will require everyone in acquisition to use the flexibilities inherent to the system and ask, **"How can I get to yes?"** Practitioners will have to deal in ambiguity and navigate a system full of exceptions. One thing is clear, however. The status quo is no longer acceptable. The speed of change and magnitude of challenges facing national security are too great to be addressed with industrial age approaches.

Our goal at the Center for Government Contracting is to facilitate government's adoption of this digital age mindset we call **Acquisition *Next***. We look forward to iterating on this playbook as we engage with practitioners, embark on acquisition case studies to help make the lessons concrete, and hope to transition to pilot programs.

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*One additional challenge that does require structural change is the resource allocation process, which will hopefully be addressed by the Commission on Planning, Programming, Budgeting, and Execution Reform. The Center has been at the forefront of this conversation with white papers, events, and articles.

A Paradigm Shift

Acquisition in the 21st century is still driven by policies and practices devised in the 1960s, optimized for the assembly lines of the industrial age. In this world, the value of a widget was in its raw materials, machining, and other physical traits. It required mass production, best achieved by comprehensive planning and tight control of execution. The factory workers were not expected to contribute their knowledge and creativity to the product line.

The economy has entered the digital age. Commodity production has been replaced by software, data, and product design—intangible capital that requires knowledge labor. For example, in 1970, most of the value of a newspaper was in the paper, ink, and printing equipment. By the 1990s, the news moved online, but firms still had to own servers. By the 2010s, almost the entire tech stack was virtualized. The largest and most innovative firms today are software natives.

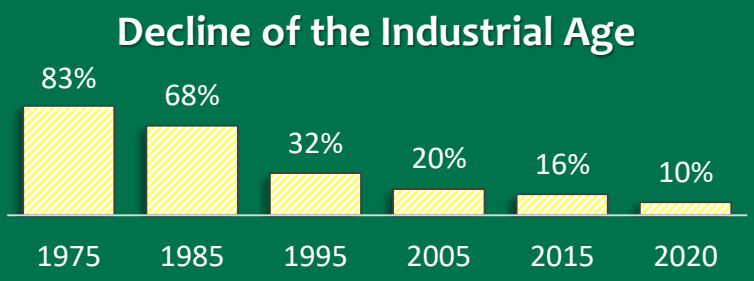
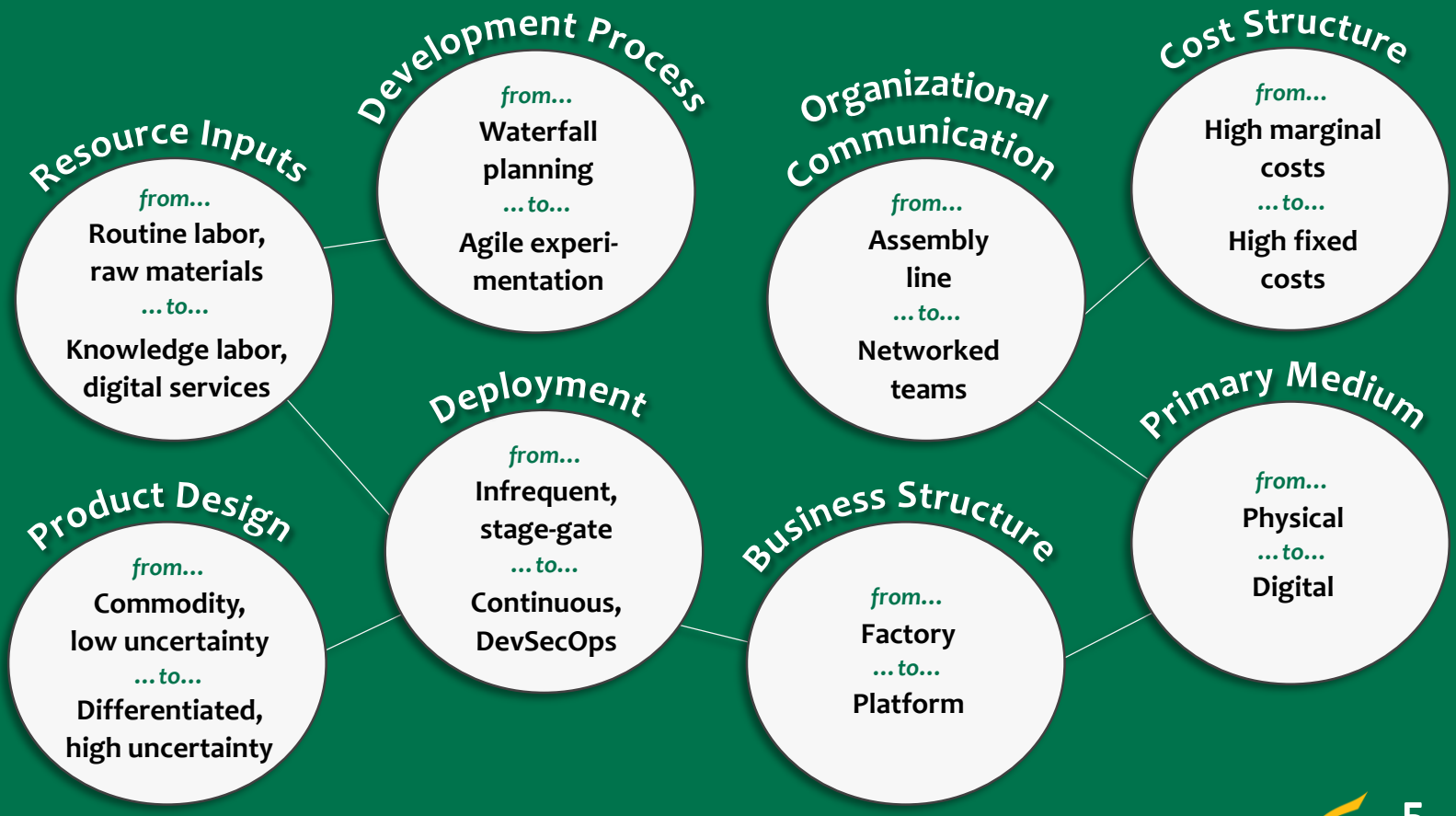


Figure 1. Share of S&P 500 market value explained by tangible assets, earnings. [Source]

> **"Software is eating the world. The corollary is that software-native teams will figure out hardware before hardware teams do software."**

Figure 2. Business Practices: From Industrial Age to Digital Age



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Goodbye Industrial Age Acquisition

"Software is probably more decisive than hardware in many cases, it quickly adapts. We have to move to a new model, a post-Industrial Age model."

Sen. Jack Reed, 2021
Speaking at a Reagan Institute Event

"Our failure to modernize as quickly as possible will most likely increase risk to the force. This makes reform of our Industrial Age acquisition system a strategic imperative."

SecDef Mark Esper, 2017
Statement to Congress on Acquisition Reform

"Our current modernization system is an Industrial Age model. It was sufficient for past threats, but insufficient to ensure future overmatch and rapid procurement."

Gen. Mark Milley, 2017
Letter to General Officers

"Despite pockets of imaginative reform and a few farsighted leaders, DoD remains locked in an Industrial Age mentality."

Final Report, 2021
National Security Commission on Artificial Intelligence

"The acquisition enterprise is currently optimized for Industrial Age procurement of large weapons systems… We must shift to align with modern industry practices."

SecAF Heather Wilson, 2017
Testimony to Congress

"We have to transition from an Industrial Age model of acquisition to something more modern."

LTG John Thompson, 2019
Speaking with Elon Musk at Space Force Pitch Day

Study Method

> **"The transition between competing paradigms cannot be made a step at a time, forced by logic and neutral experience… it must occur all at once or not at all."**
>
> Thomas Kuhn
> *The Structure of Scientific Revolutions*

How has the paradigm shift from industrial to digital age practices affected acquisition? The first place to start is with the acquisition community itself. In their experience, what has worked for software intensive systems? **Mason GovCon** set to find out by talking with practitioners in industry and government.

We framed the conversations around nine hypotheses for how the acquisition process may change in the digital age (Table 1). We then asked the participants for critical feedback to test the validity of each hypothesis. In particular, we wanted practitioners to translate the principles represented by the hypotheses into specific approaches they have used in real acquisition programs. The approaches that worked on the ground could then form the foundation of the Center's playbook. Over a three-month period, the Center interviewed 75 practitioners from a variety of functional backgrounds.

We distilled our conversations into six draft plays. The first three plays apply at the total program level and to all system types. They enable the modularity and iteration necessary for second three plays which are suited to contracts with software intensive content. The plays were opened to criticism in a series of roundtable events. Feedback was further refined into this acquisition playbook.

Our goal at the Center for Government Contracting is to facilitate government's adoption of digital era practices we call **Acquisition *Next***. We look forward to iterating on this playbook as we engage with practitioners, embark on acquisition case studies to help make the lessons concrete, and transition to pilot programs.

> **"Industrial Age acquisition practices no longer work for software intensive systems. Linearity and prediction are replaced by modularity and iteration."**

Table 1. Acquisition Hypotheses

Acquisition Element	Current State —Industrial—	Objective State —Digital—
Requirements	Stable	Iterative
Market Research	Passive RFIs	Active engagement
Solicitation	Advertise and sealed bids	Broad topic/multiple solutions
Competition	One-time	Regular
Contract Structure	Total responsibility	Modular
Source Selection	Paper design	Minimally viable product
Architecture	Unique build	MOSA or STITCHES
Pricing	Cost-based	Alternatives-based
Intellectual Property	Zero-sum	Collaborative

Program Level Plays

Three plays at the program level apply to all system types. Without a program structure that supports modularity and iteration, the software intensive plays are unmanageable.

1 Requirements

Make room for opportunities in program requirements

Separate **Big "R"** from **Little "r"**

Use **outcome-oriented** requirements

Iterate with **stakeholders**

2 Market Research

Make market intelligence a core and continuous organizational capability

Create a strategy for **active engagement**

Set up a **single-point of entry**

Carve out the budget for visits, events

3 Master the Baseline

Tailor the contracting approach to technically separable elements

System	Cycle Time	Contracting	Competition
Apps/Data	Fast (days)	Modularity	Regular
Platform	Med. (mo.)	Optionality	Periodic
Cloud	Slow (yrs.)	Responsibility	Limited

REQUIREMENTS

Make room for opportunities in program requirements

Problem: Requirements are fixed ahead of market research and experimentation, leading to overly complex contracts, neglect of new tech insertion, and fielding of obsolescent systems

Recommendation: Focus on statements of outcomes to increase flexibility in solution design and allow for requirements iteration over time

Separate the Big "R" from the Little "r":

- Separate strategic program-level requirements from tactical requirements in the product backlog
- Connect user stories in each iteration to higher-level capability statements
- Pick top capabilities for next increment and share with stakeholders

It's All About the Art of Writing Requirements:

- List statements of outcomes limited to one sentence descriptions
- Avoid prescriptive language
- Keep few non-tradeable requirements, validated with users
- Specific metrics should start modest and converge on objectives

Stakeholder Communication:

- Formalize a series of cross functional teams at multiple levels
- Refresh existing requirements into outcome-focused mission threads
- Keep an open channel with stakeholders (requirements officers, testers, users, joint interests, etc.) to iterate when advantageous
- Use collaborative tools to decentralize coordination
- Identify who is the (one) champion and who are the (few) veto points
- Avoid requirements by consensus (gold-plating)—if you get a lot of pushback you're doing it right!
- Bring industry into the process early

Success: Requirements stay aligned with technical progress and user feedback by keeping an open channel with stakeholders

Resources: DAU Adaptive Acquisition Framework website; MITRE's Accelerate Requirements

Context & Motivation

The need for adopting commercial technologies to national security use cases has never been stronger. Back in 1960, DoD funded one-third of global R&D. Today, the figure is just 3 percent. This is reflected in the fact that eight of the DoD's top ten modernization priorities are dominated by commercial technologies including cyber, quantum, space, biotech, microelectronics, networking, AI/ML, and autonomy. DoD continues to lead in hypersonics and directed energy, but more than ever government must adapt or fall behind.

Programs can struggle adapting to change. For example, F-35 pilots regularly flew with tablets in their lap forcing the Air Force to start testing integration in 2021. The problem is pervasive. In 2018, the GAO reported that the average age of major defense acquisition programs was over 14 years old. Most of these programs got started before Amazon offered cloud services or Apple introduced the smartphone.

The commercial sector is now releasing new technologies inside the "OODA loop" of govern-

ment decision-making. Acquisition officials must have the tools to take advantage of new opportunities created by the larger technology ecosystem and experiment with them to form new operational concepts within a program.

A major barrier to technology insertion is the linear requirements-pull model. In the model, intelligence defines enemy threats, operators identify capability gaps, programmers resource it, and the acquisition community at the end of this chain executes the baseline plan. It's not surprising that many important military innovations do not owe their origins to requirements, including jet engines, nuclear propulsion, ballistic missiles, and more recently the internet, GPS, night vision, lasers, stealth, and UAVs.

The answer, however, lies not in a technology-push model. An interplay between the R&D and user communities has long been known to have the most advantages.

The first play seeks to focus Big "R" requirements for the program on statements of outcomes. Certainly there is nothing novel here, but past efforts have failed for a couple reasons. First, there was little definition for how specific features were to be prioritized by the product owner in execution. Second, there wasn't a collaborative process for iterating on requirements when needed. Users, testers, and requirements officers should be included in deciding which features make it to the top of the queue for the next increment of work.

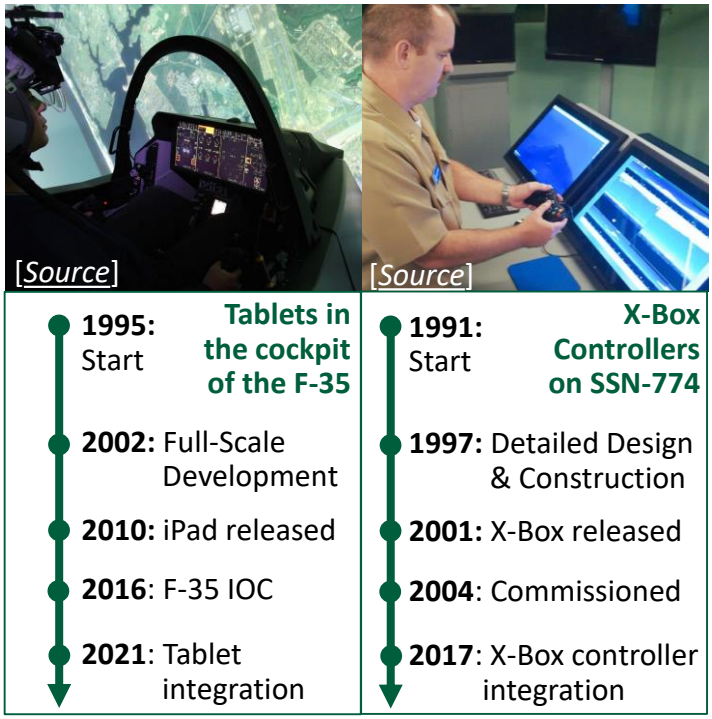


Figure 3. Examples of Lagged Integration of Commercial Technology

Formalize two-tiered requirements sets. Kessel Run has a requirements model that distinguishes strategic level requirements and user centered design. The strategic Big "R" requirements are found in a Capabilities Development Document, Capability Needs Statement, or similar. These high-level outcomes decompose into tactical Little "r" requirements found on a product backlog that get iterated on. This basic construct works not just for DoD Software or Middle Tier pathways, but all federal acquisition programs. Requirements for existing programs can be refactored with stakeholders. Figure 4 on the next page illustrates a process for iterating on Big "R" and Little "r" requirements.

Writing good requirements. The Army IVAS program for augmented reality headsets had requirements for shock-proof, waterproof, and ruggedness, but did not consider the need for soldiers to brace a rifle against their cheek, or army crawl on rough terrain. Luckily, through iterative development, they caught the issues and closed them. Of course, the Army could have predicted all of these features and made them into a long specification list. The preferred alternative is to write general statements of outcomes like "Does not impede the soldier's regular combat actions."

Prioritization is a team effort. Survivability, reliability, and lethality are all great, but if you maximize all of them then you will definitely lose mobility and range. Maybe you won't have enough money to then go after networking. Even with just a few non-tradeable requirements, the solution space may still be described by "unobtainium." A partial set of requirements may be better than asking for everything. Alternatives should be discussed with users to reach agreement on what comes first in terms of tactical-level features to be developed in the next increment.

Use collaborative tools. The translation between Big "R" and Little "r" requirements cannot be confined to the acquisition community. It must involve users throughout development rather than going up and down hierarchical chains. Directly communicate with counterparts in the combatant commands, materiel commands, requirements offices, and other organizations. Clearly define a regular cadence of interactions. Provide access to shared folders of important information and status. Use enterprise tools like Office 365 or Slack to communicate horizontally with stakeholders. There's no replacement, however, for side-by-side testing with users.

Create a map of the stakeholders. This collaborative program process requires formalizing the stakeholders and their role in the process. Major program decisions may involve numerous functional and leadership positions. It may seem each one of them is a potential veto point and thus the program must accommodate all of their additional requirements. These demands must be resisted if program officials and users alike do not prioritize them. Document these choices and be prepared to defend them to the decision authority that actually represents a veto point.

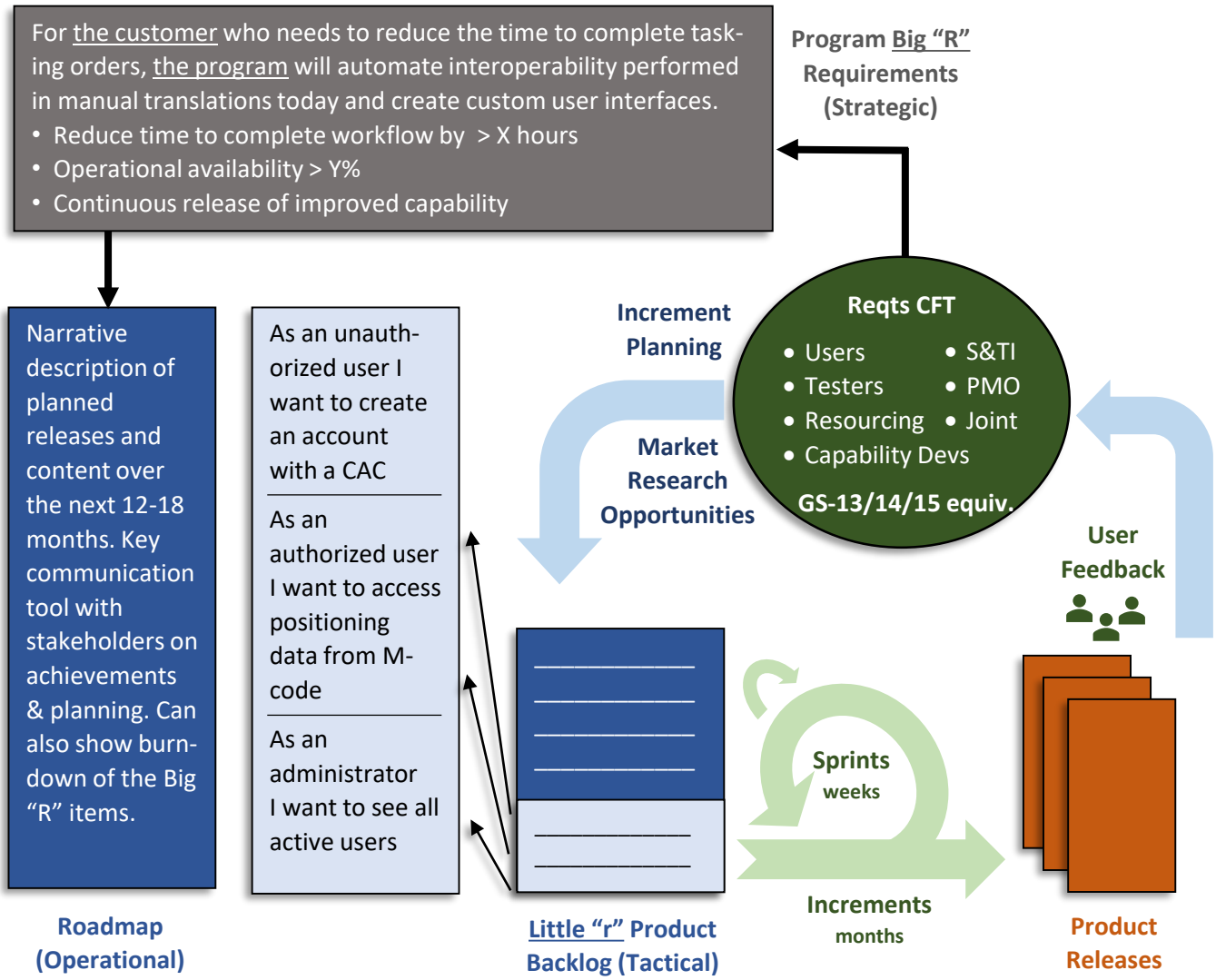


Figure 4. Illustrative Process for Iterating on Big "R" and Little "r" Requirements

Capability Over Time Curve. For traditional acquisitions, capabilities are not ready to be tested and released until they meet a laundry list of requirements, even if the last few percent of capability take half the time and cost of the entire program. Key performance parameters should not be considered static program objectives to be met all at once or not at all. A better path is to incrementally release capabilities and track progress on an evolving set of metrics. Program officials should chart a similar course with the test community by tracking capability over time curves. For example, an autonomous system might track improvements in way-point navigation or the accuracy of targets detected by computer vision. An IT system might track user adoption rates and workflow completion times. Metrics should be tailored to the program's operational context and expected to drift over time. Avoid over-concentrating on particular metrics at the expense of the program's intangibles. Goodhart's Law states that "When a metric becomes a target, it ceases to be a good measure." That's because organizations can sometimes optimize an objective regardless of the consequences.

> **"It's a sin when we refuse to break things into increments because we take options away from the commander."**
>
> Requirements Officer

Wrap Up. The acquisition process is devised with linearity in mind. Fully formed requirements are expected to pull technology along in predictable ways. When uncertainty rears its head, observers often blame requirements creep or gold-plating. In too many acquisition programs, success is measured by the minimization of disruption—by execution to plan. Yet the desire to prematurely freeze requirements before technical trades can be made incentivizes program officials to ignore new information. The move to iterative requirements reflects a process of learning and error correction. As famed philosopher of science Karl Popper observed, "Error correction is the most important method in technology and learning in general." The trial-and-error method is scientific precisely because it creates a reflexive interaction between requirements-pull and technology-push approaches, which corresponds to higher-level concepts of deduction and induction. Fortunately, even traditional acquisition programs are open to iteration. This can be accomplished by using outcome-oriented statements, formalizing a two-tiered set of requirements, creating a repeatable process of stakeholder communication, and tracking progress to capability over time curves.

MARKET RESEARCH

Make market research a core and continuous organizational capability

Problem: Market research currently responds to consolidated requirements that were not informed about the technological state of the art, and thus are biased toward legacy solutions

Recommendation: Develop an organizational capability to engage continuously with industry, identify technologies that can increase program value, and increase vendor competition

Active Engagement:

- Develop a communications strategy
- Create a narrative of the program and needs
- Attend/create trade shows, make contacts, and schedule meetings
- Keep an open door
- Access media channels
- Consult third-party experts
- Carve out the budget
- Visit contractor sites
- Interactive RFIs with demos
- Use simple language
- Make sign-up easy

Organizational Design:

- Organic capability in the PMO/PEO
- Funnel all leads to a single point of entry who can broker the right interactions
  - Cannot have source selection duties
  - Coordinate information with adjacent organizations, labs, tech accelerators
  - Designate market research duties
- Need a consistent metric for transition success

Other Tips:

- RFIs should either be focused/short to support informed requirements or broad/open to invite new ideas
- Ask vendors about their active contract vehicles

Success: The program is continually scanning the market and is able to onboard new capabilities and vendors as appropriate

Resources: DHS PIL Bootcamp; DoD Market Research Report Guide

Context & Motivation

Market research should inform virtually all decisions made on a program. For every solution planned in the master schedule, there is a constellation of alternatives. How is the rest of the world acting in similar situations? The answer changes all the time as the global economy accelerates technologies and creates new possibilities. Technological change no longer happens within the confines of programs or governments. Acquisition officials must plan for the unplanned by building the capacity for recognizing and responding to opportunity.

Market research can sometimes feel like a check-the-box exercise because so much of a program is pre-determined. Figure 5 on the next page illustrates how external organizations can influence many parts of an acquisition program before it even starts. The resulting requirements are often so detailed that only the largest primes can bid. What market research remains is out-sourced to the primes in their responses to RFIs and RFPs. The winner then has little incentive to continue market research and identify second sources after contract award. Moreover, many government officials have short tours of duty,

perhaps two to four years. Much of the execution plan has been set by predecessors.

Active engagement not only requires officials to have the time, desire, and funds, but also the opportunity for their actions to impact the program. Creating an iterative process for requirements with a community of stakeholders opens the aperture of what is possible. However, organizational design should complement the new emphasis. The types of market research each program office or laboratory needs are different.

Active Engagement

Communications Strategy. Outreach through trade shows, open doors, oral presentations, and so forth must be coordinated through a coherent communications strategy. How will the program office get the word out through traditional media, social media, professional memberships, and other channels? What will be the cadence for engagement? Look into the marketing strategies used by commercial firms such as content distribution, search engine optimization, making sign-up easy, and so forth. When interacting in public, officials do not need to go through public affairs unless there's a release of technical data. The bias should be towards allowing government personnel to communicate openly, recognizing that mistakes may be made.

Demonstration Events. One of the top priorities for a communication strategy is to provide clarity on the program narrative and on-ramp opportunities. This provides confidence so that industry can invest with an understanding of the potential revenue should they be successful. Coordinate regular market research observations as opposed to official test events. This avoids formal procedures that can stifle the discovery process. Fund coordination of the event and provide each participant $50,000 or so for their time. See in the real world what participants put in a white paper or oral presentation. Prize competitions and other alternatives are equally useful. Whatever the process, provide clear and consistent details in the communications strategy.

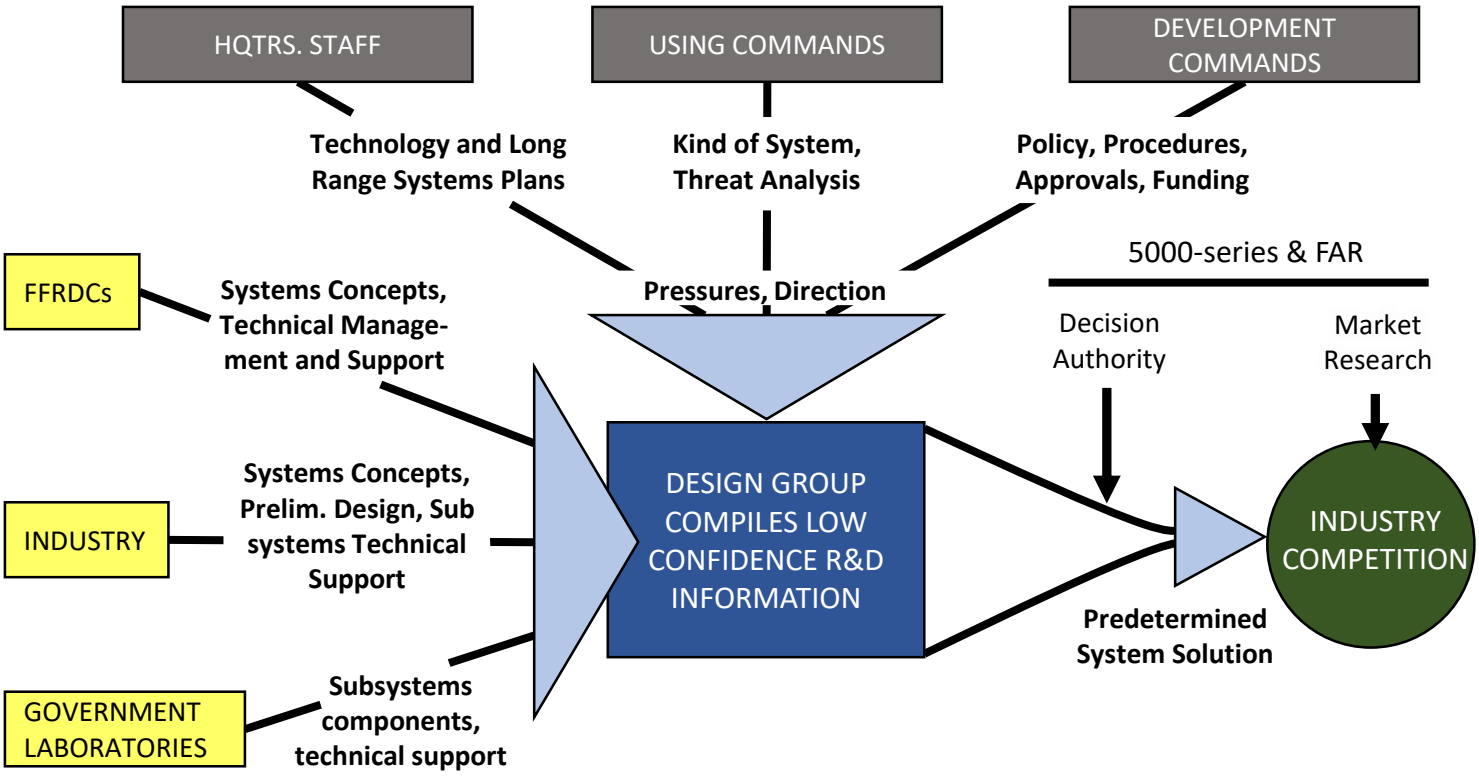


Figure 5. How External Organizations Pre-Determine Program Solutions [*Source*]

Carve out the Budget. There is rarely any funding available for program officials to do site visits or market research observations. Much less than flying out to observe performing and prospective contractors, officials sometimes do not even have the time or budget to drive 20 miles down the street. Downward pressures on workforce size at the same time as funds obligation requirements have grown squeezes out the in-person interactions that generate understanding and enthusiasm for the mission as well as oversight of the contractors. Adding a withhold to certain budget accounts can be an effective means for getting the program team out of the office to connect the figures on a spreadsheet to real technology and production.

Organizational Design

Core to the Organization. Market intelligence should be an organic capability of the program office. Information can be coordinated throughout a program executive office as the primary portfolio, and coordinated with other organizations including the labs and accelerators. There are over 30 tech accelerators in the Department of Defense, and while these capabilities should be leveraged they cannot replace the domain expertise in the program office.

Single Point of Entry. With market research being performed across numerous organizations, the problem of duplication arises. Vendors may feel like they are providing the same information over and over. Moreover, government officials act cautiously even when there's no open solicitation. Under a modular contract structure where solicitations are frequently open, protest risk may increase. In order to reduce protest risk and centralize aspects of the market research function, one individual in each program office should be designated the single point of entry. This individual may be a chief of acquisition or a deputy program manager who will never participate in source selection to avoid conflicts of interest. Rather than another functional stovepipe, the single point of entry should act as the lead facilitator of market research. This outreach official must leverage the technical knowledge in the program office, labs, and counterparts across government to broker the right interactions.

Stratification of Duties. Market research needs not only differ by organization, but functional area as well. Science & Technology officers are responsible for *strategic* market research that may have program impacts in three or more years. The single point of entry is responsible for *operational* market research that may generate new contract solicitations including demonstration events. The contracting officer is responsible for market research at the *tactical* level associated with a particular contract order. Each of these officials has their own market research needs and leverages personnel from across the organization such as the contracting officer's representatives. One of the major challenges remains the effective distribution of information. Market research is everyone's duty, but the single point of entry should serve as the organizational leader, even if market research is a team exercise.

> **"In the military, intelligence is the market research function. It's part of operations. You don't do intelligence every time there's a potential war. It's continuous."**
>
> Contracting Officer

Wrap Up. A strong argument can be made that the market research play should come first in the sequence. Requirements are increasingly impacted by new technologies. However, a continuous market research capability can have only limited impact until an iterative requirements process is established. Only then can a strategy for active engagement and a single point of entry help the program continuously insert new capabilities.

Master the Baseline

Tailor the contracting approach to technically separable elements

Problem: Requirements are consolidated such that the program proceeds according to one schedule, but different elements of the architecture or tech stack have different development cycle times

Recommendation: Determine which system elements are technically separable and pursue traditional contracting approaches for technologies with slower cycle times and modular contracts for faster moving applications

System #1	System #2	Cycle Time	Contracting	Competition
e.g., C2 system	*e.g., UAV*			
• Apps & Data	• Software	• Fast (days)	• Modularity	• Regular
• Platform	• Electronics	• Med. (mo.)	• Optionality	• Periodic
• Cloud	• Airframe	• Slow (yrs.)	• Responsibility	• Limited

Success: The program is not being built full-stack in a single contract award and new capabilities are released at differing speeds

Resources: DDR&E MOSA website; DAU MOSA Community of Practice

Context & Motivation

The 1940-1970 period was a time of change in acquisition philosophy. Traditionally, the military services focused on maturing components and integrating systems around them. The Air Force started taking a new approach in the 1950s, one that focused on total system performance and developing unique components to match.

Historian Elliot Converse described how this "weapon systems" concept was represented by the view that "All of the elements in a system should be designed and developed from the beginning as an integrated whole." As General Electric's chairman Ralph Cordiner observed at the time: "Where the need was once for a large number of general-purpose components and sub-systems, the demand is increasingly for complete systems and even supersystems." The benefits of the weapon systems concept were articulated by President of North American LJ Atwood in a 1959 congressional hearing:

1. It creates the "most advanced systems possible" by designing around subsystems that are not yet fully developed.
2. For the first time the prime contractor is "cognizant of the entire cost."
3. While accelerated technology works "against standardization of parts," single prime integrators have better control to select their own standards rather than accepting what the supplier base offers.

By the end of the 1950s, these aspects of weapon systems contracting had become the norm in the Air Force. Recognizing that subsystems usually lagged the airframe, the Navy Bureau of Aeronautics continued for a time to make key decisions on system development, review of contractor performance, and arbitrate disputes between the prime and its subcontractors. In the 1960s, contracting for a fully integrated system from a single prime contractor spread throughout

Army and Navy acquisition, for example becoming official policy of Naval Weapons in 1966.

The return to modular components with global standards was relatively slow going in the 1970s and 1980s, but picked up in the 1990s and today there are dozens of open standards used in the military including the Army's VICTORY standards, the Navy's Future Airborne Capability Environment, and the Air Force's Open Mission Systems/Universal Command and Control Interface. Yet there is still displeasure with the implementation, as indicated in the past few National Defense Authorization Acts seeking to "fully realize the intent" of the modular open systems mandate found in Title 10 US Code §2446.

The Baseline. The third play in **Mason GovCon**'s acquisition playbook seeks to revive some of the traditional business practices from the 1960s and before that enables the technical goal of modular open systems. This involves the government unpacking system requirements and modularizing the contract along technically separable components. This is important because different elements of a system have different development cycle times. For example, advances in material sciences and infrastructure move quite slowly, perhaps on the order of five to ten years or more. Aided by Moore's law, electronics can cycle through new models every couple of years. Software is even faster, capable of deploying new updates potentially every day.

Business arrangements should be responsive to product cycle times. Fielded software can change quickly, and modular contracts are well suited to continuous upgrades. Traditional approaches can be successful for infrastructure like cloud, ship hulls, and airframes due to the cost of migrating capabilities once in production. Although infrastructure migration costs can limit competition within a program, industry is starting to tackle these issues. For example, managing data centers with software and pricing based on a pay-as-you-go model have helped many commercial organizations adopt a multi-cloud strategy.

Perhaps surprisingly, the Center has not found explicit guidance advocating government to partition and manage contract tasks based on the modular system design. Instead, guidance expects government officials to identify requirements for standards in the RFPs. The DoD's Open System Architecture Contracting Guidebook for Program Managers spells out all the language and consideration for an RFP across 200 pages. This process not only limits competition, but reduces the speed of all system elements to the slowest common denominator.

> **"I think of things in terms of the timescales and the complexity of changing them. At what speed do things want to change? Platforms don't really want to change that quickly; electronics a lot faster; and software is incredibly fast."**
>
> S&T Officer

Breaking apart system monoliths gets into the controversial idea of government "owning the technical baseline." If the prime contractor isn't the lead systems integrator, then the government must be. Yet it is possible for government to fulfill its responsibilities without literally owning anything. The 2015 Air Force Studies Board paper Owning the Technical Baseline did not recommend across the board use of government reference architecture or unlimited data rights. Instead, government requires sufficient insight and control over design agent choices. There are many ways this "ownership" can manifest. Unfortunately, there are few general principles to share. Three ideas, however, will be offered.

Don't Start with Complexity. Correctly identifying all the standards and needs for government data rights ahead of the RFP creates a difficult problem. Empirical evidence shows that it is nearly impossible to build complexity from scratch. Unless the program is an incremental upgrade, the technical baseline will not come fully formed. Complex systems are instead made from relatively simple parts. For example, market intelligence should be turned into quick pilots and early integration efforts for important sub-

systems. This will help hone the technical baseline and Work Breakdown Structure, but should not be viewed as draft or beta work. Rather, it provides clarity on which standards, if any, should be put onto the larger production RFPs that will result in fielded capability. Even the father of the waterfall development strategy for software Winston Royce advocated doing it twice or else "one can expect up to a 100-percent overrun in schedule and/or costs." Use defense and national labs, FFRDCs, and industry consultation to help navigate towards a baseline.

Get in the Middle. Perhaps the most important recommendation is that government contract directly with subsystem suppliers in areas that they (1) want to avoid vendor lock; and (2) have sufficient insight and technical expertise. Often, the government will have a prime contractor do the actual integration, but the prime should not have privilege of contract with all vendors. This reflects the pattern of contract management that dominated in the 1960s and before.

Certainly Government Furnished Equipment (GFE) is frequently provided. For example, nearly half of the DDG-51 system cost including mission systems is intermediated by the government in close coordination with the prime. This modular business practice extends into the government, as the DDG-51 program manager must interface with other program offices delivering sensors and ordnance. Configuration management can become difficult, however, leading to the fear that GFE becomes either late or defective.

Even today, the government takes on a lot of design responsibility. Up to 80 or 90 percent of system costs can be pre-determined through the operational concepts, preliminary designs, and performance requirements made before the release of the development RFP. Making this responsibility more explicit by directly contracting with subsystems or software providers can improve insight and flexibility. It also allows the delay of critical decisions until more information becomes available, preserving options.

When the contractor takes on significant development risk, they are entitled to directly contract with their suppliers or vertically integrate. Self-funded efforts generally need to create cash flow along the way and will make economical choices with respect to design and standards. The government faces minimal risk and is able to keep options open for longer.

Preference for Commercial. The Department of Defense perhaps had enough weight after World War II to drive technology and proliferate its own standards. Now that the U.S. commercial markets outspend defense by eight-fold on R&D, most of the proliferating standards are outside the control of government.

If DoD wants to increase its buying power, it has to adopt commercial standards whenever possible. In the 1990s and 2000s when DoD started taking modular open systems seriously, it often ended up sponsoring open standards where the only players were traditional contractors. These standards failed to benefit from the weight of commercial improvement.

Government should actively participate in commercial standards groups that have defense-relevant capabilities. For example, the Army sits on the Robotics Operating System board, contributes more than $1 million a year to its code base, and uses the framework for military applications across a number of programs.

Wrap Up. When an entire development effort is contracted to a single prime integrator, there is little need for the iterative requirements and continuous market research advocated in the two previous plays. The ability to insert new capabilities into programs depends not just on using a modular open systems approach but choosing standards that will proliferate, thereby making it attractive enough for third-party vendors to participate.

The very idea of modular open systems challenges the foundations of a program of record. Components and subsystems should be tradeable across program "stovepipes," which also need integration into larger systems like command and control networks. Careful steps toward partitioning systems from a prime integrator should be viewed as an opportunity to take advantage of enterprise capabilities, improve data flows across the government, and reduce sole source situations.

Software Intensive Plays

Three plays at the contract level optimized for information technology, including hardware whose primary value is defined by software.

4 Agile Work Statements

Separate technical direction from contract work statements

Include: FAR, PoP, price, vision, data rights, deliverables

Exclude: List of features, technical implementation

5 Modular Contracts

Reduce risk by partitioning contract tasks over time and components

One common strategy

Multiple-award IDIQ 16.5 | 6-month FFP + 4 options | Streamlined procedures

6 Intellectual Property

Avoid vendor lock with open APIs and rights to operational data

First-Mover Strategies
- Early planning
- Lifecycle costs
- Priced options

Fast Follower Strategies
- Influence open interfaces
- Get operational data
- Delay rights to major production

Agile Work Statements

Separate technical direction from contract work statements

Problem: Technical direction memorialized in a contract based on a rigid Statement of Work restrains flexibility when assumptions prove false

Recommendation: Separate technical direction from contract requirements and use a living roadmap adjusted to the product backlog and user feedback

Contract Includes:

- FAR, PoP, price
- Repeatable security, testing, and deployment processes
- Licenses and data rights
- Product vision, deliverables
- Meetings and reviews

Contract Excludes:

- Specified direction of technical implementation
- Prioritized list of features
- Long contract data requirements lists

Success: Contractors held accountable for delivery and integration through a disciplined process

Resources: GSA Agile Contract PWS Template; TechFAR Handbook; FAI Periodic Table; MIL-HDBK-245D

Context & Motivation

Government leaders have good reason to talk about the need for agility. The principles of agile have not only been adopted by the fastest growing startups in the commercial sector, but also by the largest incumbent firms including IBM, AT&T, Procter & Gamble, John Deere, and many others. Survival in commercial markets demands adaptation.

Though many definitions of agile exist, the Agile Manifesto provides four guiding principles:

1. Individuals and interactions over processes and tools
2. Working software over comprehensive documentation
3. Customer collaboration over contract negotiation
4. Responding to change over following a plan

The Agile Manifesto finds a companion concept in the idea of formal relational contracts. Nobel Prize winning economist Oliver Hart noted how strategic partnerships between organizations can be improved by focusing on desired outcomes and a process to manage the relationship.

For example, when Dell selected FedEx in 2005 for its hardware return-and-repair procedure, it drew up a 100+ page document filled with "supplier shall" statements. For nearly a decade, FedEx met the letter of the contract but neither side was happy. Just two years after switching to a formal relational contract, they were able to reduce costs by 42% and scrap by 67%. Both companies now consider the approach a best practice to be applied with all relationships.

In many ways, the heritage of defense contracting is colored with agile processes. Lockheed's Kelly Johnson liked to tell a story about the P-80, America's first jet. He got a letter contract to start work drafted, approved, and signed within 90 minutes. Similarly, in 1955 the entire specification for the F-4 Phantom II con-

tract fit within two pages. By contrast, in 1980 the C-17 specification consistent of 13,516 pages.

The long list of "supplier shall" statements that has pervaded government contracting works best for well-defined procurements. For innovative products such as software, the process gives only the illusion of control. When one thing is incentivized, another is disincentivized. This leads to the perplexing situation faced by Dell and FedEx where contract obligations are met but neither side is happy. This situation is also shared by many government programs.

When technical solutions are uncertain, it is wise to provide room for discretion in contractual relationships. As defense contracting scholar Frederic Scherer said in 1971, "given the kinds of technical problems characterizing modern-day weapons developments, inflexibility of contractual instruments is incompatible with economy."

In practice, this formal relational contract means removing much of the technical direction that presumes the product end-state from the contract work statement. In its place, there's a vision and a process. There is a lot more detail for crafting agile work statements including templates in the TechFAR Handbook, FAI Periodic Table, and GSA Agile Contract PWS Template. Essentially, the government buys a partner rather than a pre-specified product.

Collaboration. Once the contract provides for flexibility in technical direction, government product owners—often the contracting officer's representatives—must feel empowered to make decisions so long as it fits within the constraints set by the program. The agile contracting approach recognizes that priorities will change. Collaboration substitutes for extensive contract negotiations, and requires a mission command mindset throughout the organization. The product owner should consider the following collaborative tips:

- Face-to-face communication is best
- Trust the contractor for the first few sprints
- Do not reprioritize the product backlog in the middle of sprints
- Facilitate the contractor's access to end users
- Clearly identify how deliverables are validated

Accountability. Long work statements and thousands of scheduled tasks only give the appearance of accountability. Contractor schedules, however, often conceal rework and delays until after the sunk cost bias kicks in where government loses its leverage. By contrast, agile processes reduce customer risk by delivering functionality early. Delivered software is the primary measure of progress rather than percent complete or earned value. The product owner must thoroughly document artifacts from agile development and integrate them into the program requirements process.

> **"The backlog replaces the list of tons of requirements. And with iterative contracting, you throw out the IMS, give a capacity over a period of time, and prioritize based on product owner's vision and user feedback."**
>
> Tech Co-Founder

Deliverables. One fear of the agile approach is that funds will be sunk without a way of measuring progress to program requirements. Vaporware is the term for software development that doesn't leave behind user functionality. The contract should specify deliverables, such as sprint documentation and dates for capability releases. To ensure the right features get delivered, government product owner should help define acceptance criteria for items on the Little "r" requirements backlog. As the product reaches a stable baseline, performance or functional requirements can be added to the contract. This differs from an integrated master schedule because there is no critical path or baseline change requests that limits adaptation.

Course Correct. Rather than switch vendors at the first sign of trouble, product owners should talk with company managers to address any instances of personnel being unqualified or uncooperative before re-competing the effort. Similarly, product owners should be monitored by the product lead and the contracting officer to verify that they are qualified to carry the responsibility entrusted to them.

Scaling. Though many will admit that agile processes seem to work for small applications, they have doubts about whether it applies to major programs that will involve hundreds or thousands of people. However, Gall's Law states that all complex systems that work evolved from simpler systems that worked. Evidence for this statement is as pervasive in nature as it is in systems engineering. Project Hindsight in the 1960s, for example, found how each major weapon system required dozens if not hundreds of significant technologies be developed before the system could be made possible. If all these technologies were scheduled as part of a single development program, then efficiency is lost. The chance that all components will advance and integrate as planned is vanishingly small.

> **"A complex system that works is invariably found to have evolved from a simple system that worked. The inverse proposition also appears to be true: A complex system designed from scratch never works and cannot be made to work."**

Adoption. Take an agile approach to replacing legacy systems. The alternative to replacing one major system with another is to "boil the frog." According to the fable, if you put a frog in boiling water it will jump out, but if you slowly turn thestove heat up it will slowly cook to death. Similar- ly, rather than requiring that a new system meet all the requirements found in a legacy system, it can introduce the core functionality, solve niche problems that legacy systems cannot address, and use work-arounds to fill gaps. User adoption can then drive system transition and help steer the direction of continuous development cycles.

Legacy Program Example. The Navy's F/A-18 program office has been using an agile process for many years. The program office had nearly 700 organic technical folks who could take ownership of short one-page little "r" requirements. Technical direction was separated from the contract and the government leads worked closely with the contractor. This allowed the program office to issue task orders within one week. More than 200 separate requirements were being worked at any time, and they could be deployed as part of regular capability releases. While this sped up fielding and lowered costs, it required a critical mass of organic technical capability and a culture to support it.

Wrap Up. There is empirical evidence that agile development processes work. Yet these pro- cesses often fail in organizations when the business functions remain fixed to industrial era methods. The failed situation is sometimes called "water-agile-fall." For contracting to support agile software development, work statements should invite a collaborative environment that ensures the Government has sufficient insight and participation in design choices. The con-tract remains legally enforceable, and account-ability is improved through early releases of functioning product.

Major Elements of a Performance Work Statement for Agile Contracts

Vision statement. Provide the high-level scope and business motivation.

Agile processes. Identify the core construct of the desired process:

- Sprint duration. Allow the contractor to define a sprint duration, but should be short (two to four weeks).
- Product Backlog. A list of features or user stories to be developed as well as defects to be fixed. User stories often come in the short format "As a ___, I want ___ so that ___." Each item will be assigned an effort estimated by the development team and a business value estimate by the product owner. A solicitation may ask for an initial product backlog, but this isn't to be contractually binding.

Definition of Done. During each sprint planning meeting, the parties will agree to the conditions of acceptance testing for each item on the backlog. Tests should be conducted and passed, code has been reviewed, standards have been met, and documentation has been completed. It defines whether the product is shippable.

Business. Regular business items like type of contract, price, and period of performance. Additional items may include: cybersecurity requirements, intellectual property, terminations, and technology standards.

Roles and responsibilities. Besides the contracting officer and procurement manager's duties, identify at least three additional roles and their responsibilities in agile "ceremonies":

- Product Owner. This is generally the Contracting Officer's Representative, who communicates the customer vision, takes the lead of prioritizing the backlog, and participates in sprint planning/review activities.
- Development Team. A cross-functional team which performs on each sprint. Contractor should provide key personnel, skill types, and hourly rate.
- Scrum Master. A contractor who ensures cooperation between the Product Owner and Development Team, but is not the project manager. Attends sprint planning/review activities.*

Deliverables. Agile contract deliverables should not require specific features sets, but instead:

- Product backlog at the beginning of each sprint
- Reports at the end of each sprint on design files, product demos, performance metrics, etc.
- Development prototypes when required, at the end of a sprint or task order
- Code repository of the source code that corresponds to government rights

For more resources, see the Agile Contracts primer, Contracts for Agile Software Development, and the book Agile Contracts.

Modular Contracts

Reduce risk by partitioning contract tasks over time and components

Problem: Numerous layers of contract incentives and management controls, designed for major hardware efforts, create high transaction costs to modular contracting

Recommendation: On-board with a BAA/CSO solicitation, transition to multiple-award IDIQ using six-month FFP tasks (There are several approaches to effective modular contract structures, this is one)

Implementation Details:

- BAA/CSO Funnel: white paper, oral presentation, proposal, BPA/BOA award
- Next, multiple awards to FAR 16.5 IDIQ
- Defined on-ramp/off-ramp period
- FFP to avoid compliance regulations
- Six-month PoPs, base + four options
- Repeated orders with two-step process

Other Approaches:

- Quick starts: OTA, 2373, or SBIR
- Simplified: BPA or BOA
- SW factories: FFP/LOE, FSS, T&M by talent area
- "As a service": Consumption-Based Solutions
- Traditional vendors: CPFF/LOE

Success: Outcomes from one phase provides inputs to the next, and contractors do not feel like they are in proposal-mode all the time

Resources: US Digital Services Playbook; DHS PIL Bootcamp; DAU Contracting Cone

Context & Motivation

Back in the 1950s and 1960s, management experts started deploying two general methods for improving federal contracts where the guiding hand of the market was absent. First was the use of incentives, such as providing award fees or sharing in the profit/loss. Second was participation in the contractor's internal controls, exemplified by the Program Evaluation Review Technique (now called Earned Value Management).

RAND analyst Oliver Williamson complained in 1965 how the management experts did not even "consider task definition as a means of influencing contract behavior." He continued,

> "… neither the manipulation of profit incentives nor the monitoring of contract progress can be expected, in any dependable sense, to yield significant improvements in contract performance as long as the specification of the task remains unchanged. From a contractual point of view at least, the 'systems approach' to weapons procurement which has prevailed since 1953 appears to be distinctly suboptimal."

He advocated partitioning program tasks into smaller efforts, which indeed had been the norm for the Army and Navy. Williamson went on to be a founder of the transaction cost theory of economics and won a Nobel prize for it in 2009. Along with Armen Alchian, Burton Klein, and William Meckling, the early transaction costs economists got their start examining systems acquisition at RAND. Yet their advice was largely ignored by the Department of Defense, which adopted the long-duration "total responsibility" concept found in the Total Package Procurement and Total Systems Performance Responsibility.

The first TPP contract for the C-5A led to a bailout of the contractor after high cost growth

and performance shortfalls. A congressional report determined that "Total-package and other large contracts should be broken down into smaller, more manageable segments."

In 1996, Congress put modularity into law for information technology programs. Title 41 US Code §2308 states, "To the maximum extent practicable, the head of an executive agency should use modular contracting for an acquisition of a major system of information technology." This is reflected in FAR 39.103, making modular contracting the preferred approach for digital products.

Modular contracting is a companion concept to the previous play on agile work statements. When technical direction is separated from work statements, accountability for performance is no longer built into the contract. Modularization and shorter periods of performance creates an incentive for the contractor to continuously deliver or risk being replaced. Williamson noted advantages in modular contracts in 1968:

1. It reduces the amount of uncertainty and hence increases objectivity in contract negotiations, reduces the felt need for defensibility in administering contracts, and permits more reliable evaluations which in turn allow cost-performance reputation effects to be assigned with confidence. Each of these effects should help to prevent excessive contract costs.
2. It creates a contract environment in which the full potential of parallel R-and-D approaches can be exploited.
3. It complements R-and-D strategies which emphasize the need for maintaining options by providing support for work on adaptable components and flexible capabilities.
4. It permits greater competition by increasing the number of eligible contractors.
5. It lends itself to sales and employment stabilization.

Unfortunately, many in the acquisition community believe modular contracts induce greater risk. An integrated master schedule (IMS) outlining all important tasks from beginning to end provides something to measure against. While an IMS gives the appearance of risk reduction, an analysis shows that many IMSs actually hide task performance until 60 or 70 percent complete when major rework and delays are recognized. The FAR clearly states that modular contracts "reduce program risk." This is because of early and continuous feedback on product.

Another major concern is that modular contracts increase transaction costs rather than reduce them. For example, the procurement administrative lead time (PALT) in the Army was 180 days on average for a contract of $1 million or more and the figure grows to 600 days for $50 million or more. Turning a single $50 million contract (600 days) into fifty separate $1 million contracts (50 x 180 days) could increase administrative work by 15-fold!

While the FAR 39.103 advises for a PALT of 180 days or less, in most cases modular contracts can be awarded in less than two weeks. This is made possible by the lightweight structure of the agile work statement. It has been accomplished by several program offices By cutting modular contract PALT from 180 days to 14 days, the work required for fifty $1 million contracts is made comparable with a single $50 million contract.

Many practitioners did not feel that modular contracting lowered transaction costs in their experience. In most cases, workload increased. Yet they often felt it was still the right thing to do. Programs that had adequate government staff and a few years under their belt were more likely to have a repeatable process.

Modular Contracting Tools. Modular contracting can be achieved using a number of tools in the contracting cone. One path recommended in this playbook is to use a Broad Agency Announcement (BAA) or a Commercial Solutions Opening (CSO) to receive proposals on a broadly stated topic. These solicitations can stay open for long periods of time, use written proposals or oral presentations, result in one or many awards, and allow for quick, merit-based

selections. Simplified acquisition procedures are often paired best for this stage, such as a blanket purchase agreement (BPA) or purchase orders on a basic ordering agreement (BOA).

Promising firms can then compete for bigger opportunities by being added to a multiple-award Indefinite-Delivery, Indefinite-Quantity (IDIQ) contract during an on-ramp period. Roughly 40 percent of all defense contracts use IDIQs, and the GAO recently found only one-quarter used multiple awards. FAR 16.5, however, prefers multiple-award IDIQs which creates fair opportunity and relieves some administrative burden. For example, FAR 15.3 source selection and FAR 6 competition requirements do not apply. This allows multiple-award IDIQs to use the full range of best practices in DHS PIL Bootcamp including oral presentations, confidence ratings, and comparative evaluations. These best practices are also available to federal supply schedules (FAR 8.4) and simplified acquisition (FAR 13).

FAR 16.505(b)(ii) allows the contracting officer to "exercise broad discretion" and "keep submission requirements to a minimum" using "streamlined procedures." It is also the only contract type in the FAR that explicitly advises consideration of FAR 39.103 modular contracting. These advantages make IDIQs a good choice for allowing contractors to compete for larger firm-fixed price contract tasks. Firm-fixed price is preferred, especially when dealing with non-traditional contractors, because it is exempted from the six business system requirements described in DFARS 242-70. Moreover, tasks should be structured in a way that supports incremental accomplishment, such as one base award and four options of six-months each. This approach can also be paired with FAR 14.5 two-step sealed bidding if time allows.

While this process is used by some program offices, there's never a one-size-fits-all approach. Many other contracting tools can be used, as is often repeated in our interaction with acquisition practitioners. What they share is the outcome that the contractors do not feel like they are constantly preparing proposals. Rather, past performance should directly feed each subsequent phase.

The approach to modular contracting should be added to the acquisition strategy to make sure there is alignment over time. Rotating acquisition and contracting officials can lead to a loss of knowledge, creating a reversion to traditional methods. A **strategy for modular contracting** should describe how contract types fit with the situation. Considerations for the strategy include:

- **Product line:** Based on the standards for interfaces and data exchange, what parts of the system are contractually severable? Sensors, compute, and data services often are. Software intensive elements should be given preference for modular contracting.
- **Life cycle:** For market research activities and experimentation using BAAs or CSOs, maximize use of simplified acquisition vehicles. For prototyping work, Other Transactions Authority are useful and can transition into production if planned for. Engineering and Manufacturing Develop- ment might be done on FAR-based IDIQs. Continuous upgrade efforts can benefit from sole source negotiations. Production and sustainment contracts, however, may avoid modularity and consider financing options when appropriate.
- **Vendor pool:** If nontraditionals may be competing, strong preference for FFP or OTAs should be provided to avoid numerous business requirements. Nontraditionals may benefit from single-award IDIQs because they can be treated as commercial items (DFARS 212.201). If traditional primes are the likely competitors, then cost reimbursable contracts may have advantages.
- **Integrator:** Modularity is preferred when government has more technical expertise to oversee contractor-led effort. When government is the integrator and uses development services, such as at a software factory, there are often advantages to using federal supply schedules or fixed price level of effort contracts. When government does not have the staff to monitor the contractor, large traditional contracts make sense.

- **As a service:** Whenever possible, buy operational capability using consumption-based solutions. These will often be digital services like cloud computing but can apply to many situations with a metered price like transportation, space-based sensing, counter-UAV, and more.

Reviews. Just like agile work statements require continuous collaboration between supplier and customer, so does modular contracting. Many major programs have quarterly integrated program reviews with the contractor, which itself can seem like a lot when the contract spans several years. Yet these infrequent checkups often make the customer and their stakeholders suspicious that they are getting taken advantage of. When progress meetings are more frequent, everyone is on the same page and feels invested in the solution which lowers tensions.

> **"Applying industrial era principles to digital era technologies is a recipe for failure."**
>
> RADM Lorin Selby
> Chief of Naval Research

Functionals should review the work of their counterparts at the contractors at the end of sprints. The participants should be the "doers" rather than higher level management or business development. Users can be brought in as much as practicable for their feedback on functionality. Their buy-in will be crucial for successful transition and fielding. These frequent reviews should not be run in the traditional manner with slide preparation and risk matrices. Functionality should be the primary thing contractors have to prepare, making the interaction lightweight but informative. Major reviews every six months or year can then be used with the full program team. These may look like more traditional reviews. There should be no surprises at these meetings, and they should be tied to contract options.

Grow Organic Capabilities. A good way to build up government technical expertise is to bring on advisory and assistance services to support technical direction. Rules for these contracts are found in FAR 37.201 while FAR 9.5 describes the rules for conflict of interest. Advisory and assistance services can be bought from a vendor, FFRDC, university, or consultancy. The purpose is not to offload technical work to the service providers, but rather to have them work hand-in-hand with government staff to grow in-house capabilities—think of an apprenticeship model.

A major consideration should be defining exit criteria. Technical services should probably not extend past two years or the government may become reliant. The support is most crucial in the early phases as the program navigates towards a technical baseline. When competition gets narrowed down and intellectual property gets hammered out, the services contract can finish.

Wrap Up. The FAR prefers modular contracting when it comes to information technology because it reduces risk and incentivizes contractor performance. When paired with agile work statements, government can take full advantage of commercial development practices. Creating a modular contracting strategy can help the formulation of a repeatable process. One common strategy is to use a multiple-award IDIQ with six-month fixed price tasks. The preference for contract types may change depending on where the program is in the lifecycle, participation of nontraditionals, and other factors. These choices should be outlined at a high level in the modular contracting strategy. Performance at major reviews should be directly tied to options and influence future awards. Using advisory and assistance services contracts to help build technical acumen in the government staff is a best practice, but exit criteria should be defined early.

Intellectual Property

Avoid vendor lock with rights to interfaces and operational data

Problem: MOSA can turn programs into "big bang" efforts with long lists of directed standards, asking for data and license rights to virtually everything

Recommendation: Rather than focus on specific standards, influence a microservices architecture with rights to interfaces and operational data

Principles:

- Communicate IP needs but don't let it bog down contracting while there's competition
- Focus on federated development rather than an inflexible consensus on global standards
- Order Interface Control Documents and Interface Exchange Requirements
- Enable on-demand translations between standards, e.g., STITCHES tool

Things to Consider:

- Setting up a CI/CD Pipeline with a software factory or FedRAMP vendor
- Containerize each app using well-defined interfaces
- Utilize an abstraction layer for hardware to speed up test
- Strategies for continuous testing
- Leverage latest open source tools

Success: Vendors can be onboarded quickly if needed, particularly at the application and data layers, and contractors can keep IP to their "black boxes"

Resources: FAR Part 27 and DFARS Part 227; DAU IP Guidebook Suite; DoD OTA Guide; SoS Technology Integration Tool Chain for Heterogeneous Electronic Systems

Context & Motivation

Not only is commercial spending on R&D far outpacing the government's own, a simultaneous trend has been a shift in sources of economic value from tangible to intangible capital. No longer is a company's competitive advantage found in its physical plant, equipment, and inventory. Instead, the competition is increasingly dominated by intangibles such as software, data, and product design. Back in 1975, these intangible factors only explained 17 percent of the S&P 500's valuation, the rest being found in tangible assets and earnings. By 2020 the intangibles accounted for 90 percent.

Unlike industrial goods, intangibles can be freely reproduced. The value is in the original idea and can easily spillover to the competition. "Information wants to be free," starts a common phrase, "but creators need to get paid." This explains why industry is "terrified of giving up IP rights" to government for meager revenue opportunities. Responses range from "our IP is our company" to "VCs don't want to touch a DoD contract because the IP might get out to the competition." IP is an important contributor to the fall of new entrants in defense contracting from 15,000 in 2010 to just 4,000 in 2019. If DoD wants the best commercial firms solving military problems, it will have to respect their primary asset—intellectual property.

At the same time, DoD must retain its unique needs for data rights. For example, most Web 2.0 firms like Facebook, Amazon, Apple, and Google have exclusive ownership of all the data their users generate. Those photos you post on social media don't belong to you. By contrast, DoD must have rights in critical mission data that contribute to the planning and execution of a war. Operational data is an enterprise capability,

and that means accessibility to other defense organizations and even vendors.

Like many other aspects of acquisition, IP policies have seen a pendulum of reform. The recent standup of the DoD IP cadre and issuance of DoDI 5010.44 marks the latest swing towards increased guidance on technical and software data rights. The last major period started in 1984 with the enactment Title 10 US Code §2320 and culminated in the 1995 rule change to the DFARS that reflects today's regulation. In that time, the Packard Commission Report found that "suppliers have become alarmed by DoD's increasingly vigorous pursuit of unlimited rights in technical data to be used in fostering competition."

> **"Government is so afraid of vendor lock that they drive away the vendors they need most."**
>
> Contracting Officer

It seems the pursuit of IP gets exhausted due to the strains on contracting and the vendors outlasting or out-lawyering the government. By 2001, Congress held hearings on how IP policies were holding back innovation. DoD's guide on IP management stressed commerciality, specifically negotiated rights, and using performance-based acquisition to obviate the need for data rights.

IP issues laid dormant in the 2000s. The post-9/11 tranche of defense programs did not sufficiently plan for IP. After they went through a cycle of Nunn-McCurdy breaches between 2007 to 2013, the vendor-locked programs transitioned to the field. Defense officials found themselves unable to drive competition, perform organic maintenance, and access data. The Army led the charge with a Data & Data Rights Guide in 2015, followed by the Section 813 Panel initiated in the FY 2016 NDAA.

There exists a fundamental tension in IP guidance. DFARS 227.7103 and 227.7203 for non-commercial items directs DoD to only acquire the technical data and software data rights "necessary to satisfy agency needs." Usually this means deferring data rights acquisition to the latest point possible. By doing so, however, DoD loses leverage in negotiations. Therefore, guidance also requires lifecycle IP planning very early in program development, causing defense officials to protect themselves from uncertainty by requiring too many rights.

Modular Open Systems. The government has two major concerns with IP: avoidance of vendor lock and promotion of interoperability. In both of these cases, modular open systems architecture (MOSA) provides a theoretical remedy. A program could deconstruct the system into the relevant modules and create a systems map labeled according to whether it was government-funded, privately-funded, or used mixed funding. Using the open standards, government could "plug-and-play" modules, thereby improving competition and lessening the need for data rights. Open standards can also create enterprise efficiencies by fostering communication between systems and the sharing of components.

The problem, as discussed above, is that there is not enough information available at the development RFP stage to pre-specify standards. It can take a long time to reach a global agreement on a standard, and even then, it's hard to roll out across a diverse set of systems. The Air Force, for example, has used Link 16 for decades. It still isn't fully adopted and exists in several configurations. Locking in new standards, moreover, will not help existing programs that make up the vast majority of defense capabilities.

MOSA has met some success over the years—such as the Navy's Acoustic Rapid COTS Insertion effort, the Army's Ground Common Infrastructure Architecture, and the Air Force's OMS/UCI—but remains elusive as a global solution. This is indicated by renewed emphasis in law and guidance. Government officials must often resort to acquiring intellectual property to protect themselves where MOSA could not.

Fortunately, commercial firms have made a great deal of progress breaking down large, tightly integrated software systems. This has been achieved using architecture best practices in interface design, messaging syntax, documentation, and protocols for discovery. By contrast

defense contractors often don't know their interfaces, requiring months to reverse engineer.

With documentation in hand, DARPA has also created a suite of tools including STITCHES which can create a translation between interfaces, supporting ad hoc interoperability (Figure 6). This means DoD programs do not have to slow down until a global consensus on standards is enforced, but can quickly swap modules or systems on-demand. As former deputy director of DARPA Dan Patt explained in plain language:

> "Maybe I shouldn't think about interoperability as trying to achieve a universal language. I shouldn't try to define Esperanto and force everybody to talk Esperanto. Maybe I should do on-demand translation—the Google translate equivalent… It might seem less elegant, but it's a lot more practical. And STITCHES is the equivalent of that, but for systems."

Mason GovCon's final play for software intensive systems seeks to protect the government's interests while reducing its need for intellectual property. Vendor lock can be avoided by using best practices for interface design as a criterion for progression through agile development. Ordering of data rights for the interfaces and operational data can be obtained when there is more information but before competition ends. Again, since there is no one-size-fits-all approach, we suggest two general tracks:

"First Mover" Strategies. When government is a "first mover," it is pulling commercial development along. Companies aren't bringing a lot of self-funded investment to the plate because the core technologies are not dual-use. In these cases, government should make clear its intent for acquiring more extensive data rights according to guidance. This is particularly true for government-led development such as occurs in defense labs and software factories.

"Fast Follower" Strategies. As more of defense systems are built from commercial technologies, the mixed funding rule leading to government purpose rights is overly restrictive. A company could have funded 99 percent of the technology and face losing their IP if the government invests just one percent. Long discussions might then occur on what is meant by a "readily segregable" work element (DFARS 27.408). When the government is acting as a "fast follower," it should avoid acquiring data rights until its ready to move forward on a major contract associated with a program of record.

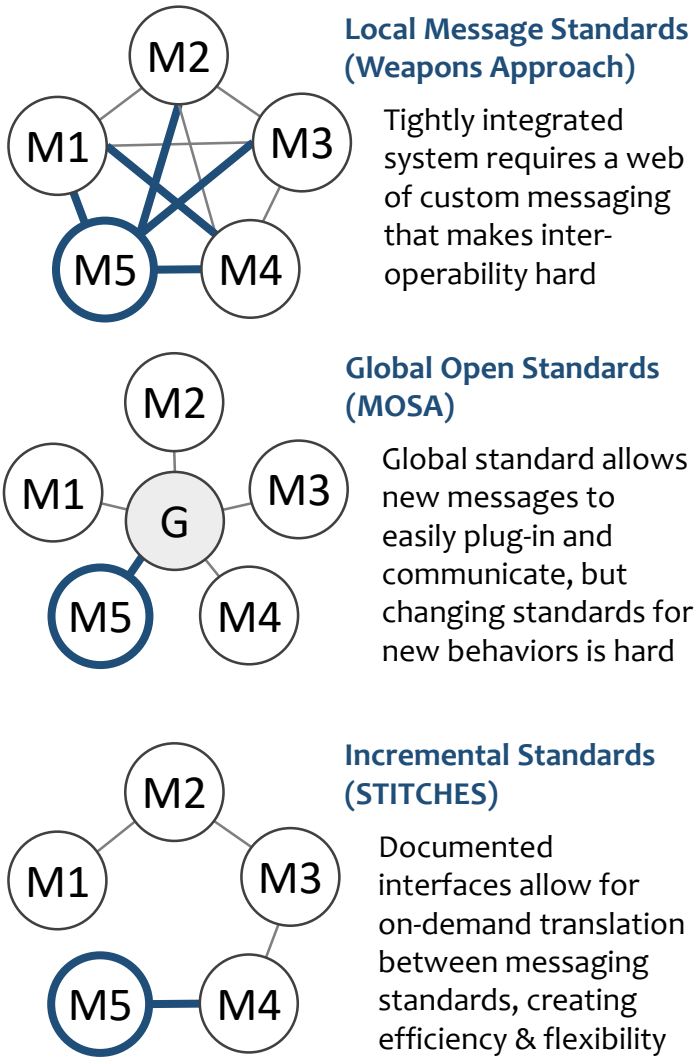


Figure 6. Comparison of System Messaging Standards [Source]

Treat Nontraditionals Differently. A major complaint of startups and commercial companies is that their self-funded IP is at greater risk than the taxpayer-funded IP investment made by traditional primes. As one small business association representative remarked: "… government practice attempts to acquire intellectual property and fails to do so in most large procurements, but does acquire intellectual property when contracting with small, innovative high-technology firms or outside commercial firms."

Government's hands are not tied when contracting with nontraditionals. Flexible IP is one of the primary reasons Congress gave DoD Other Transactions authority when research and prototyping is required. Since contracts with any nontraditional business unit can use commercial item procedures (DFARS 212.102), government can follow FAR 12 and commercial data rights and licensing terms (DFARS 227.7102 and 227.7202). Title 10 US Code §2320 also favors specially negotiated licenses.

Communicating IP needs. Contract solicitations should not include blanket requirements for government purpose rights, but rather specify the government's objectives for data rights. For example, the government may need the ability to swap an application with a competitor. The contractor could propose adopting open standards or it could provide data rights to custom interface documentation. For another example, the government may need to store data generated in military operations on a government specified cloud solution and share that data with other vendors. Hardware examples include the ability to perform organic maintenance and repair. These statements of use cases in solicitations allow the contractors to propose tailored solution that may be greater than limited or restricted rights but less than government purpose rights.

Source Selection. Most "first mover" strategies will use FAR 15 source selection procedures that are cumbersome. This includes the value adjusted total evaluated price process for determining best value. It requires adjusting the offeror's price based on the "value" of data rights included. Yet this method is fraught with difficulties in terms of valuation methods.

By contrast, "fast follower" strategies should veer towards contract procedures exempt from these source selection procedures, including FAR 16.505, FAR 8.4, FAR 13, and CSOs. Comparative evaluations require no ratings and provides a high degree of flexibility in evaluation and selection. Written evaluations can be streamlined and use on-the-spot evaluations. See the DHS PIL Boot-camp for more information on these approaches (Techniques 5 and 8).

Timing Data Rights. Today's "first mover" policies are geared toward early identification of IP needs and deferred delivery of the rights and data. Guidance suggests adding separately priced contract line item numbers to the contract. Competition in the development award incentivizes vendors to propose and reasonably price data rights. The government can exercise the option at its discretion. This practice works best for once-in-a-generation system that, after the development contract is awarded, loses competition.

A core idea of this playbook, particularly for software intensive systems, is modularizing large programs and iterating quickly. This means early contract awards are no assurance of large volume ordering, but are more likely initial experiments. At this stage, the government is not reliant on any contractor. It can influence open standards and documented interfaces along the way by maintaining competition. Only when government considers making a major purchase of the capability and down-selects to a single company is the government threatened by vendor lock. A successful development strategy should delay data rights negotiations to this stage when both parties in the relationship have something to lose. The vendor faces the loss of a major production contract while government faces the loss of competitive pressures.

Non-Disclosure Agreements. Government often needs delivery of the software code and documentation in the early phases of development in order to conduct testing. Rather than acquire data rights, a non-disclosure agreement (DFARS 227.7203-7) offers a model in line with commercial practices and provides a legal basis for enforcing confidentiality. This practice will help delay the acquisition of data rights.

Wrap Up. For software intensive systems, government has relatively low needs for data rights if it can keep competition open and enforce industry best practices in terms of documenting interfaces. Owning the operational data is also imperative to interoperability and enterprise-wise capabilities, but these rights can be delayed until production contracts and fielding. These considerations provide government a way to engage nontraditionals as a "fast follower."

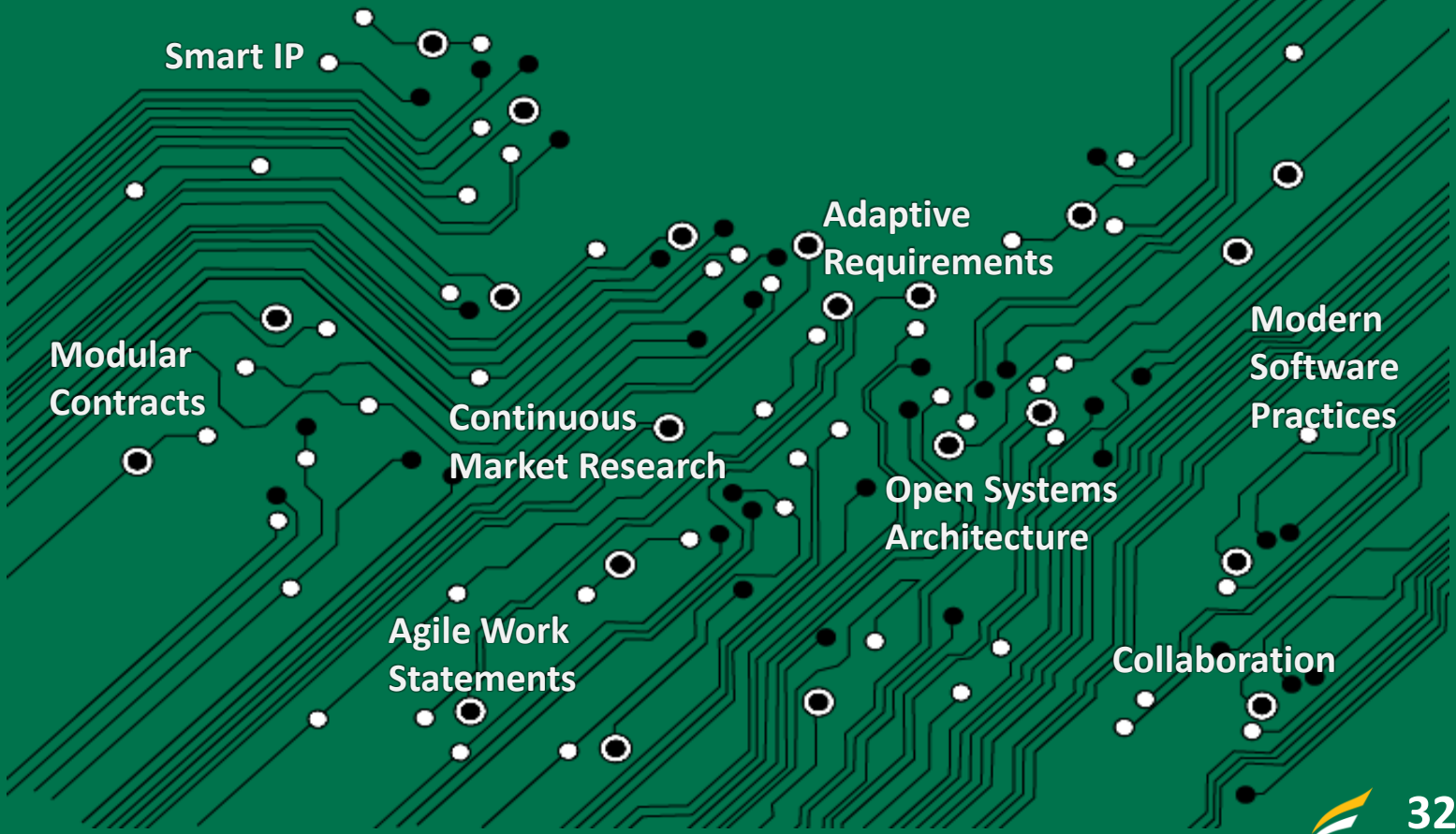
Call to Action!

As the United States moves into what many fear will be a turbulent decade, major geo-political outcomes may depend on the conduct of today's acquisition professionals. This is not only true in the obvious case of national security, but also in civilian programs. There was a time when government programs broke boundaries and created confidence in a brighter future for the nation.

> **"I believe it is the duty of each of us to act as if the fate of the world depended on him. Admittedly, one man by himself cannot do the job. However, one man can make a difference."**
>
> Admiral Hyman Rickover

Government programs can become leaders in innovation again. But it will take more than playbooks and templates. It will require everyone in acquisition to use the flexibilities inherent to the system and ask, **"How can I get to yes?"** That means practitioners will have to deal in ambiguity and navigate a system full of exceptions. No playbook can tell them what must be done. No substitute exists for integrated domain expertise. And yet no excuse can be made for failing to adopt the **#AcquisitionNext** mindset: modularity, speed, iteration, competition. Everyone knows the direction is correct. But words alone cannot change the culture of acquisition—it takes action.

This playbook is not yet over. **Mason GovCon** has much more to investigate on how the paradigm shift from industrial age to digital age practices affects acquisition. Our plays will continue to be tested and refined against real world experience. Please help us improve these plays with your feedback, find compelling case studies or pilot programs, and spread the word throughout the community. The next acquisition paradigm is already here.



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