UNIVERSITY OF MARYLAND

ROBERT H. SMITH SCHOOL OF BUSINESS

SCHOOL OF PUBLIC POLICY

Research paper on

Time Value of Data Decision Modeling

for

Major Defense Acquisition Programs

Applications of contract economics theory and hold-up scenarios to challenges in Department of Defense valuation of Technical Data Packages and Intellectual Property in dynamic time-bound markets

May 2025

Report Authors

Frank Goertner, William Lucyshyn

Research Contributors

Terrence O'Brien, Jon Crocker, Joseph Bailey, Wedad Elmaghraby, Harrison Hill, Ryan Huddleston

UNIVERSITY OF MARYLAND

Our Task

Our Intent …

- Help U.S. government program executives envision new decision models and tools for long-term contracts involving significant quantities of digital resources owned and economized by sole-source contractors.
- Open the field for further study by economics, business, and public policy researchers beyond defense acquisition experts.

… with an initial focus on:

Core fields of study in contract economics:

- solutions to economic hold-up problem scenarios;
- life-cycles of digital intellectual property and data;
- value and depreciation of intangible assets; and
- options contract modeling.

UNIVERSITY OF MARYLAND

Our Team

UMD, Robert H. Smith School of Business

- **Frank Goertner** (Management & Ops)
- Jon Crocker (Business Law)
- Terrance O'Brien (Finance)
- Joseph Bailey (Decision Operations & IT)
- Wedad Elmaghraby (Ops Management)
- Harrison Hill (MBA Research Assistant)
- Ryan Huddleston (MBA Research Assistant

UMD, School of Public Policy

- **William Lucyshyn** (Center for Governance of Technology & Systems)

UMD-DOD, UARC

- Applied Research Laboratory for Intelligence & Security (ARLIS)

UNIVERSITY OF MARYLAND

Our Approach

Section 1

Defining the Problem

Background

DoD's Time Value of Data Challenge

What is a hold-up problem?

Types of economic hold-ups in DoD

Options for mitigating hold-up problems

Section 2

How Holdups Have Been Addressed in Other Industries

Real Options: Pricing the Future of Tangible or Intangible Assets

Patent Pooling: Reimagining the Process of IP Stewardship

Tech Data as a Service (TDaaS): New Options for Data Access

UNIVERSITY OF MARYLAND

Our Approach

Section 3

Implications for DoD Contracting in MDAPs

Are **Real Options** an Option for DoD Intermediate Holdups?

Elements of a Notional Real Option for MDAP Parts and TDPs

Could an MDAP **"TDP-Library"** Circumvent Process Holdups with Pooled Innovation?

IP Pooling within DoD
Establishing a Non-Profit OTA Consortium
Delegation of Authority to a Commercial Vendor (e.g. IP/TDP Escrow)

Is **Tech Data as a Service (TDAAS)** Worth Piloting for a Future MDAP?

Which Tool for What Holdup? A Proposed **Decision Guide**

Sketching a DoD **Decision Matrix for Time Value of Data**

Conclusion

Insights and Recommendations

1. Many parts merit many tools
2. Cost-based pricing handicaps options
3. Public-private IP pools are underexplored
4. Further interdisciplinary study is warranted
5. Even the best model will not be enough on its own

Sec. 1 – Defining the Problem

What is a hold-up problem?

*"**A hold-up problem emerges** when two parties refrain from efficient cooperation because of imbalances in bargaining power between them. Hold-ups involve two factors:*
(1) a requirement for non-contractible specific investments prior to the transaction, and
(2) uncertainty between parties on the exact form of optimal transaction (e.g., quality, number of units, time of delivery)."
- p. 3

***"Products and services most at risk of hold-up problems** are those with significant asset specificity: the degree to which investments in a specific transaction for a specific purpose hold value above and beyond their use for any other purpose."*
- p.3

		Investment Characteristics		
		Nonspecific	Mixed	Idiosyncratic
Frequency	Occasional	Purchasing Standard Equipment	Purchasing Customized Equipment	Constructing a Plant
	Recurrent	Purchasing Standard Material	Purchasing Customized Material	Site-Specific Transfer of Intermediate Product Across Successive Stages

FIGURE I
ILLUSTRATIVE COMMERCIAL TRANSACTIONS

(Williamson, 1979)

Foundational works on hold-ups include:

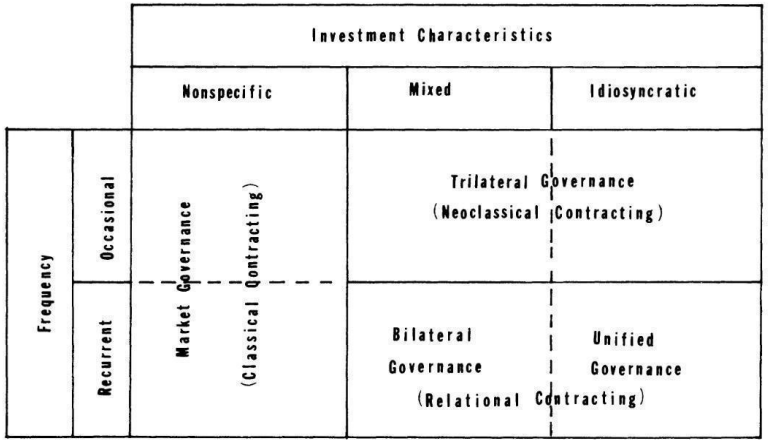
- *Markets and Hierarchies: Analysis and Antitrust Implications* (Williamson, 1975)
- *Vertical Integration, Appropriable Rents, and the Competitive Contracting Process* (Klein et al., 1978)
- *Transaction-Cost Economics: The Governance of Contractual Relations* (Williamson, 1979)

Sec. 1 – Defining the Problem

How are hold-ups mitigated?

Matched Governance

- ✓ ***Bilateral*** (e.g. options clauses)
- ✓ ***Trilateral*** (e.g. patent pooling)
- ✓ or ***Unified*** (e.g. service contracts)



(Williamson, 1979)

FIGURE II
MATCHING GOVERNANCE STRUCTURES WITH COMMERCIAL TRANSACTIONS

Sec. 1 – Defining the Problem

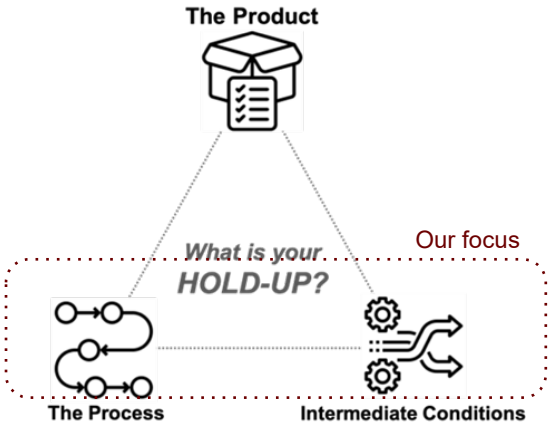
DoD's hold-up problem

DoD MDAPs are special but not unique

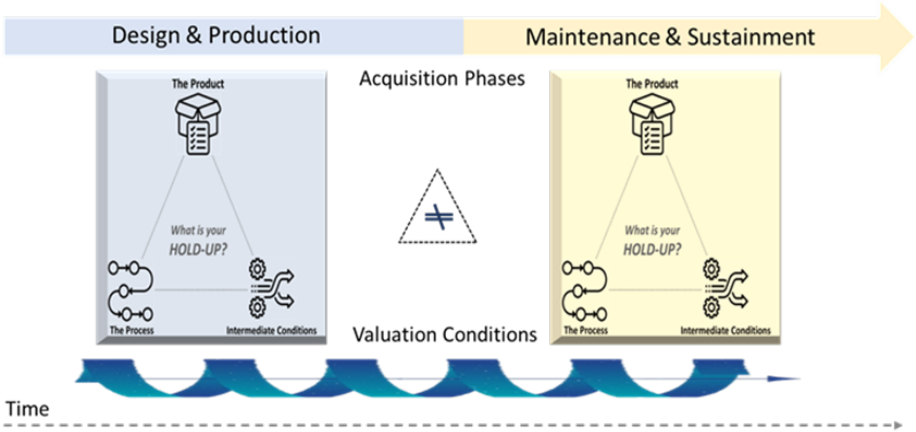
Multi-decade maintenance & sustainment phase

Overlapping, but not unprecedented, economic challenges

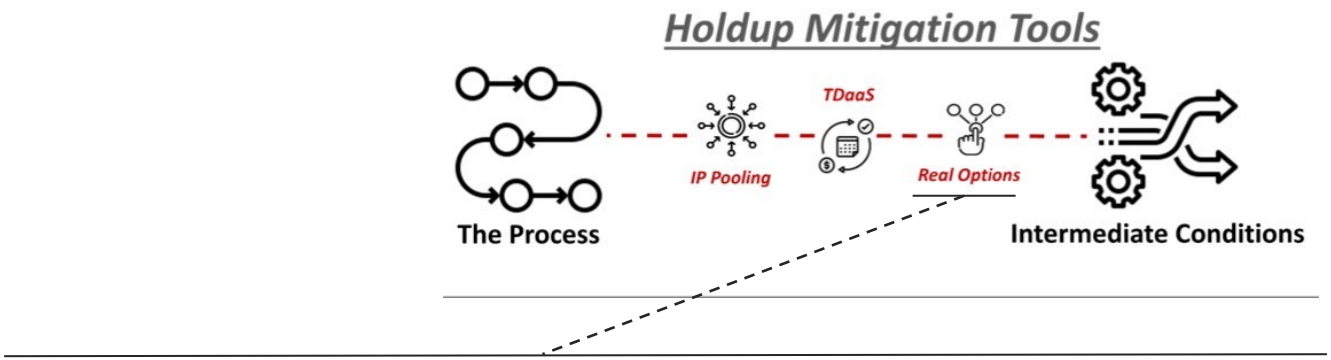
- ✓ Specialized nature of components
- ✓ Regulatory structure of defense contracting
- ✓ Intellectual Property (IP) in a monopoly-monopsony market



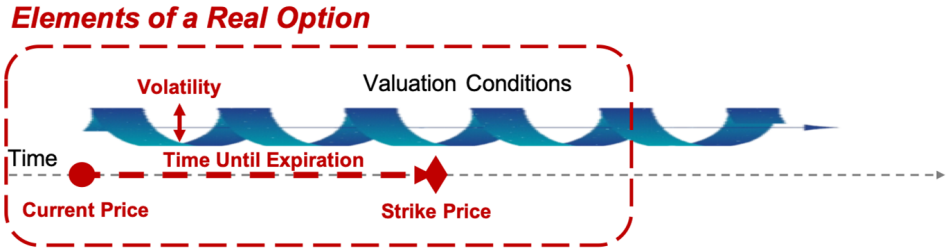
Mixed valuation of tangible + intangible assets: especially in TDPs



Sec. 2 - Market Solutions to Holdups



Real Options: Pricing the Future of Tangible or Intangible Assets



"By offering the potential for leverage, diversification, and strategic positioning, options contracts empower market participants to tailor their risk exposure and optimize financial objectives with precision." p. 6

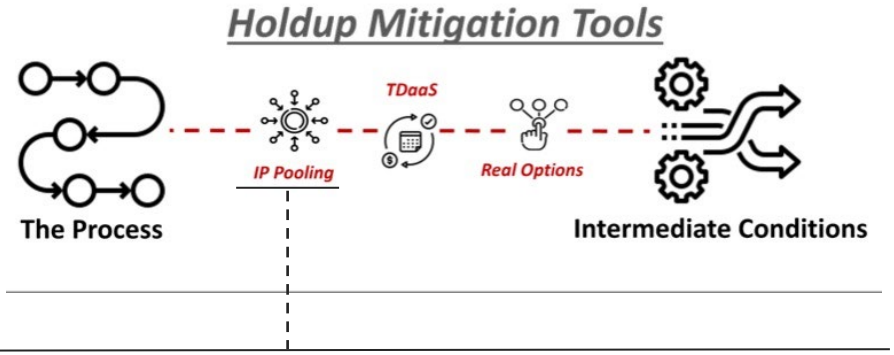
Tangible Assets Case: The Real Estate Industry

- ✓ Fixed assets, transparent markets & mature regulations,
- ✓ Price, volatility & risk easy to model
- ✓ Options help price known expectations

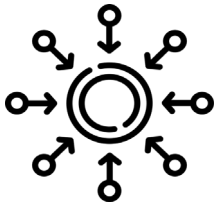
Intangible Assets Case: Digital Currencies

- ✓ Evolving assets, developing markets & shifting regulations
- ✓ Options help hedge against unknown risks

Sec. 2 - Market Solutions to Holdups



Patent Pooling: Reimagining the Process of IP Stewardship



"If options contracts offer pit stops or offramps on the road from today's market to that of the future, patent pools repave the road to smooth and quicken the ride." p. 8

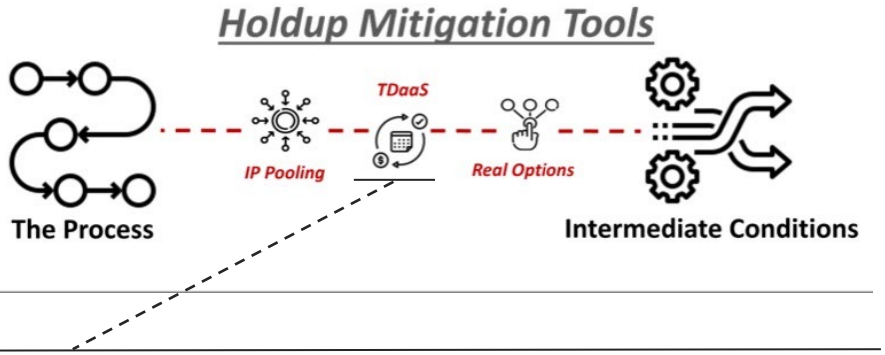
BioMed Industry Case: mRNA Vaccines for HIV + COVID-19

- ✓ Incentivizes IP sharing in a regulated regime
- ✓ Preempts "royalty stacking"
- ✓ Can accelerate R&D

Cautionary Case: 20th Century Film Industry

- x Poorly regulated, can evolve toward collusion
- x Can decelerate R&D

Sec. 2 - Market Solutions to Holdups



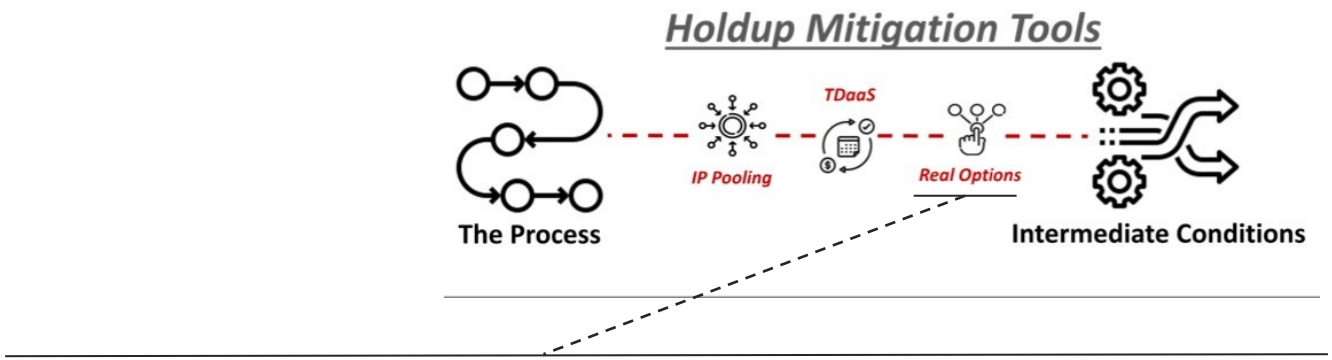
Tech Data as a Service (TDaaS): New Process and Options for Data Access

"Similar to Software as a Service (SaaS), which has become ubiquitous among contracts in commercial IT, TDaaS contracts could conceivably break down bilateral hold-ups by changing the process governing the transactions in which they occur." p. 9

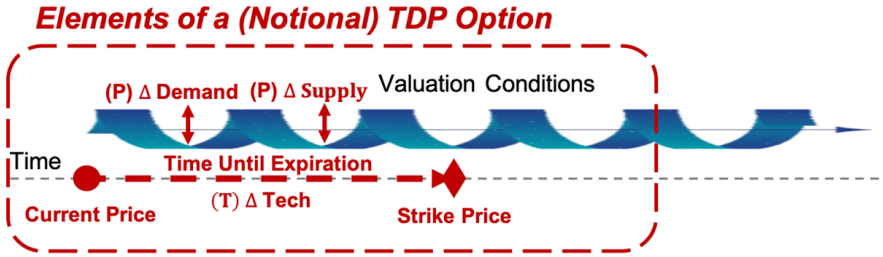
Potential Advantages

- ✓ Quick and accurate purchase, lease, or access to TDPs and their digital subsets
- ✓ Continuous procurement may save money by avoiding a single all-or-nothing negotiation
- ✓ Adaptability to future needs in an environment of uncertainty regarding future data needs
- ✓ May stimulate more dynamic price modulation
- ✓ Compensated for maintaining & updating TDPs throughout sustainment phase

Sec. 3 – Implications for MDAPs



Are Real Options an Option for DOD MDAP Intermediate Holdups?



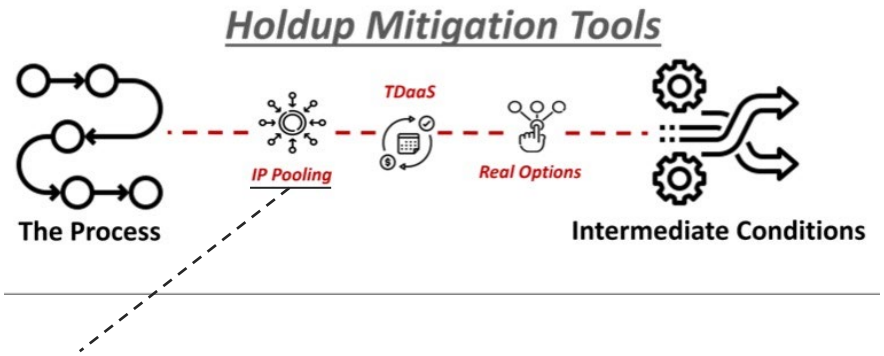
"In order to adapt the hold-up mitigating potential of real options contracts… [DoD] would need tools to account for forces and factors beyond [MDAP] supplier cost that may impact price valuation of contracted components over time." p. 10

Need Alternatives to Cost Plus Incentive Pricing

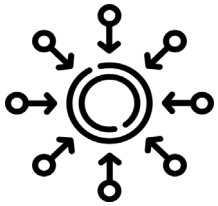
Dynamic Market-Oriented Pricing

- $ *Variable economic forces*: ↑monetary inflation; ↓scale efficiencies (beyond programmed production), ↑Supply chain erosion or disruptions
- $ *Variable technical factors*: ↓new production materials or processes; ↓tech-prompted market expansion or disintermediation
- !! *Needs of the Service*: Historical MDAP program data; peer MDAP data; tech & econ informed pro-forma analysis; dynamic future force modeling; enterprise and industry transformation analysis.

Sec. 3 – Implications for MDAPs



Could an MDAP "TDP-Library" Circumvent Process Holdups with Pooled Innovation?



"The 2021 case of TransDigm offers a case study of how IP holdups can even be exploited to extreme ends… Applying private sector approaches to pooled IP management, three methods for consolidating and managing DoD TDPs and IP data rights merit attention: (1) IP pooling within DoD; (2) establishing a non-profit IP consortium; and (3) delegation of IP governance to an independent commercial vendor." p. 12

Pooling within DoD

- DoD office tasked to pool shared IP & TDP maintenance across all phases of MDAP
- Tasked & funded for "pooling" IP & data access assurance as a "library" service independent of MDAP acquisition process, program, or contract requirements

Non-profit OTA Consortium

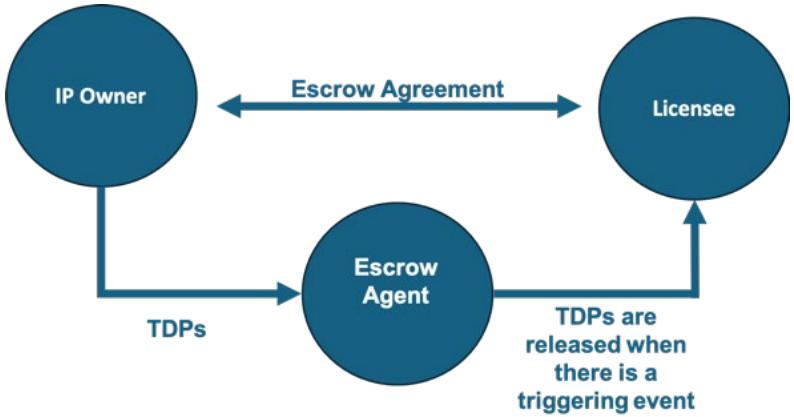
- Use of Other Transaction Authority (OTA) to establish a non-profit consortium for pooling TDPs and managing data rights with and in other DoD program enterprises (modeled on DIB Consortium).

Delegation of Authority to a Commercial Vendor: An IP/TDP Escrow

- Contract for a commercially maintained TDP Library

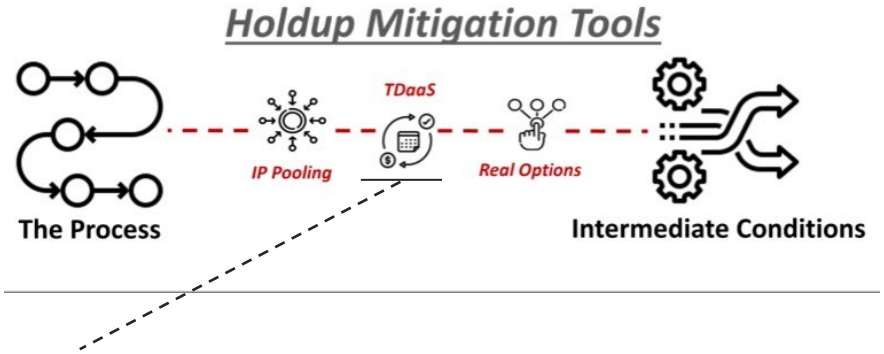
Sec. 3 – Implications for MDAPs

Modeling an IP/TDP Escrow



"mirrors a tool widely used by both Amazon and Walmart - the IP escrow – in which a third party holds the vendor's data and data rights in an escrow account. If an original supplier goes out of business, discontinues the product, or fails to perform on the part of a contract, the buyer ensured sustained access to the data and data rights."
p. 13

Sec. 3 – Implications for MDAPs



Is Tech Data as a Service (TDAAS) Worth Piloting for a DoD MDAP?

"TDaaS offers an "all of the above" approach that, in some cases, may prove to have the most effect." p. 13

Imagine…

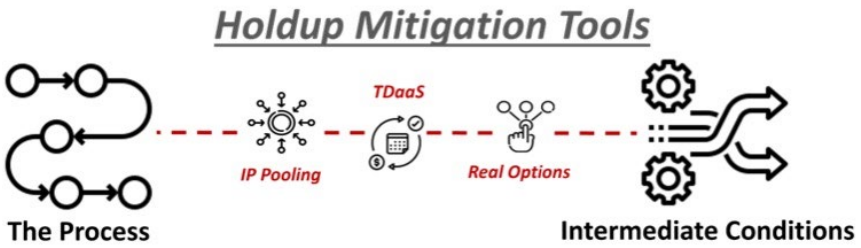
- a service-based contract for TDP access and maintenance that incentivizes the manufacturer or supplier and sustains their survival…
- with a real option priced to account for: probability of use beyond the first most likely replacement period of the part as well as probability spread among new manufacturing techniques, supply chain efficiencies, and modified demand.

Selective use - worth a pilot

- Likely cost-prohibitive to negotiate and sustain for every part.
- Worth a try for parts with frequent replacement projections subject to hold up of acquisition processes known to be unsustainably unaffordable or risky.

UNIVERSITY OF MARYLAND

Sec. 3 – Implications for MDAPs



Which Tool for What Holdup? A Proposed Decision Guide

"Decision matrices serve as decisional guides, rather than policies or procedures. Through a series of questions, the strategist is invited to dissect a complex multi-faceted dilemma into addressable decision bins... For the sake of this model, the matrix is represented as a 'decision cube.' p. 14

Decision 1: What is the Hold-up?

Decision 2: Is the Hold-up Worth Mitigating?

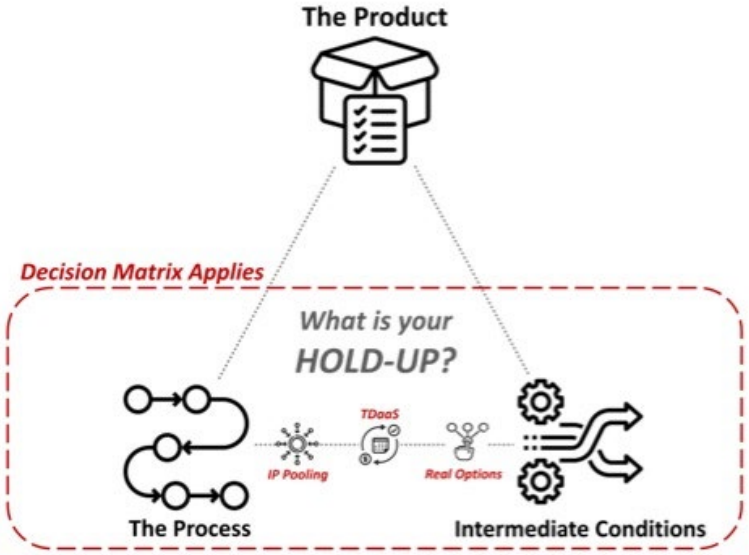
Decision 3: What Solution-Bins Make Sense?

Decision 4: What Tool Fits Best?

Sec. 3 – Implications for MDAPs

Decision 1: What is the Hold-up?

"This first question, more than any of those that follow, demands creative and consequential deliberation... The key is to think past current circumstances and ask if the current hold-up is grounded in forever exclusive and immutable conditions related to the type of part or its use." p. 14



Question 1A

- Could you imagine any future in which the part or its components could be produced by alternate suppliers (including DoD) or current suppliers could sell the part to alternate customers (besides the MDAP)?
- If YES, there is likely a hold-up at play, at least in part, on account of Intermediate Market Condition. This would be an ***Intermediate Hold-up***.

Question 1B

- Could you imagine use cases or alternative supply options for the part or its components today if not for present contract or data rights constraints?
- If YES, there is likely a hold-up at play that derives from the DoD acquisition process as presently regulated or applied: a ***Process Hold-up***.

**Note that the answer to both questions could be YES, in which case you have components of both an Intermediate Hold-up and Process Hold-up sourcing contract inefficiencies potentially worth mitigating.*

However, if the answer to both questions is NO, then you are likely constrained by a Product Holdup, in which case the remainder of this decision matrix is unlikely to help.

Sec. 3 – Implications for MDAPs

Decision 2: Is the Hold-up Worth Mitigating?

"For Process Hold-ups and Intermediate Hold-ups, the decision matrix of mitigation tools can be thought of as an eight-binned cube. However, not all the bins will likely merit attention... Because consumption, or replacement, in turn, drives the enduring value of those parts' TDPs, that can also serve as an indicator for the exigency of a new approach." p. 15

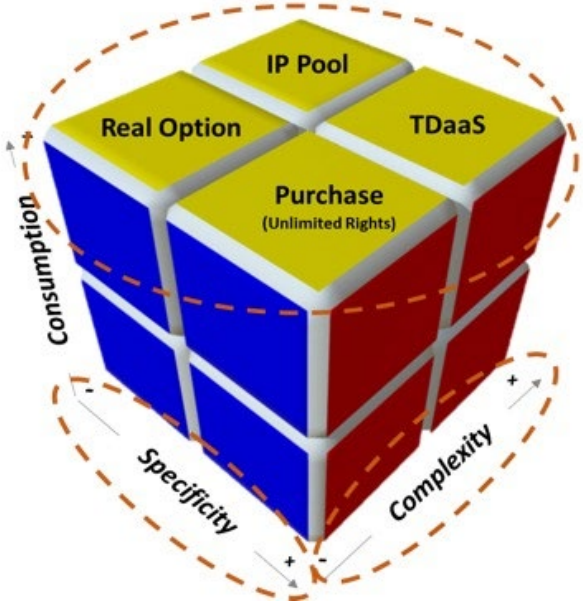
It needs to be worth program time and effort

- High consumption parts are where the real value in mitigation may be hidden
- If a part contracted for acquisition in the design and production phase of the MDAP is intended to last the full lifespan of the platform, there is likely little value in dedicating decision time to contemplating new tools for better contracting and maintenance of its TDP.

Sec. 3 – Implications for MDAPs

Decision 3: What Solution-Bins Make Sense?

"The next question is how to think across the bins to select the mitigation solution that fits best. Starting with an evaluation of two broad hold-up variables may help: Part Specificity and Part Complexity." p. 15

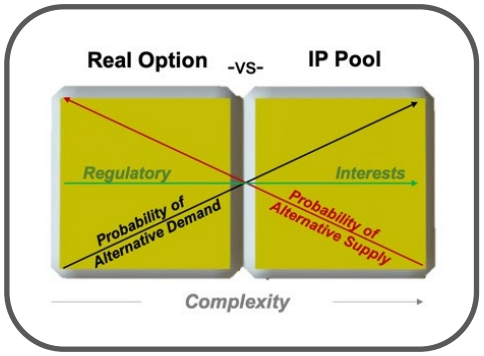


Consider…

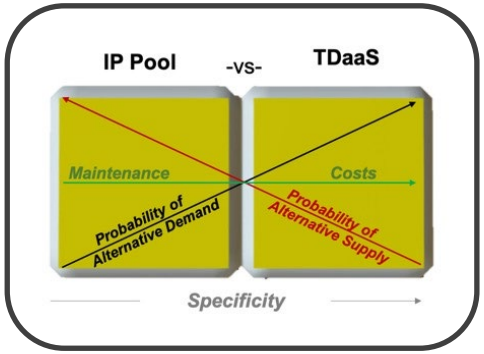
- Parts that are ***less specific*** (i.e. potentially usable beyond the MDAP) and ***less complex*** (i.e. more easily transferable for supply beyond initial contractors) offer the most opportunity to apply ***Real Options*** to transactions involving the parts' TDPs
- Parts with ***higher specificity*** but still ***low complexity*** it may be more suited for DoD to ***forgo the options*** to purchase or pursue Unlimited Rights to the TDP up front.
- Parts that are ***more complex***, either in terms of construction or IP, it is likely less favorable for DoD to secure and maintain their TDPs independently. Therefore, collaborative approaches that share both cost and risk, such as ***IP Pooling or TDaaS*** could be better options.

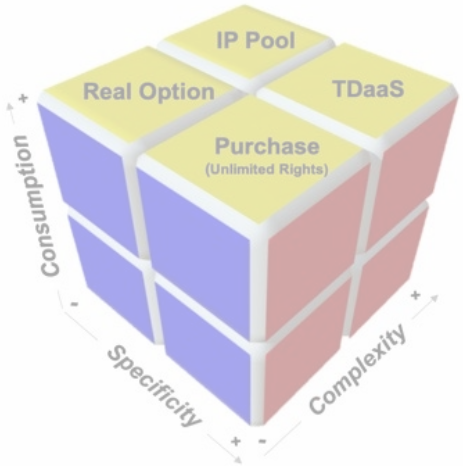
Sec. 3 – Implications for MDAPs

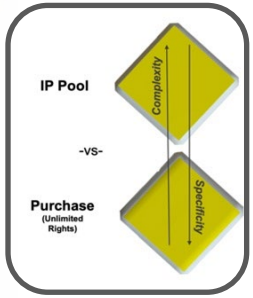
Decision 4: What Tool Fits Best?

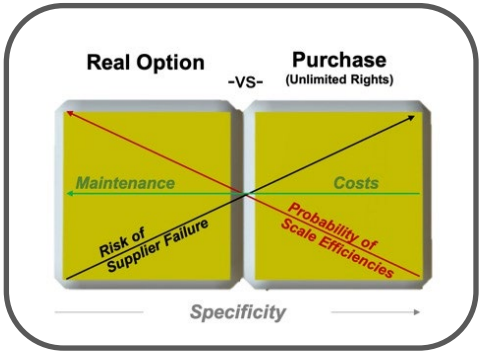


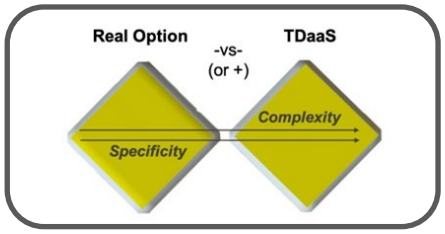
"The questions and decisions above could lead to a place on the cube seemingly between or across two solution bins… zooming into the decision space to apply other variables introduced in the earlier sections could help." p. 16

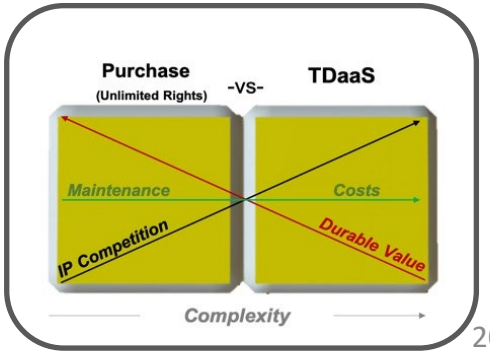












Conclusion

Insights and Recommendations

1. **Many parts merit many tools**
   - Risk being overwhelmed and contractually paralyzed by mass –vs- risk of oversimplification to assume all components and their TDPs should be priced and acquired en masse under bundled pricing and rights. One size cannot fit all.

2. **Cost-based pricing handicaps options**
   - Single first step DoD could make to improve its positioning on Process Hold-ups and Intermediate Hold-ups + pave the way for real options & TDaaS: start weaning from Cost Plus Incentive pricing as the default approach. OTAs can help.

3. **Public-private IP pools are underexplored**
   - Majority of discourse on IP in DoD is focused on policy and regulatory reform. These may overshadow exploration of more collaboratively disruptive organizational solutions like IP Pools. Additional investment and experimentation in his arena may be worthwhile.

4. **Further interdisciplinary study is warranted**
   - Validity and functionality of this framework merits testing within real DoD acquisition scenarios – historical and current. Then, the models and variables deserve more mathematical attention.

5. **Even the best model will not be enough on its own.**
   - DoD acquisition is a career and a culture that needs to be addressed.

UNIVERSITY OF MARYLAND

Questions?

MARYLAND SMITH
FUTURE of GOVERNMENT MANAGEMENT INTIATIVE

go.umd.edu/SmithFedGov

Frank T. Goertner

Director, Federal & Veteran Affairs

+ Tech Management Grad Programs

Robert H. Smith School of Business
University of Maryland
3570x Van Munching Hall
College Park, MD 20742

Phone: (240) 581-4405

Email: fgoertne@umd.edu