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Middle Tier Acquisitions and Innovation

Dr. Amir Etemadi—Amir Etemadi received a Doctor of Philosophy degree in electrical engineering from the University of Toronto, Toronto, Canada. He is an Assistant Professor in the School of Engineering and Applied Science in the Department of Electrical and Computer Engineering and the Department of Engineering Management and Systems Engineering, and teaches masters- and doctorate-level courses in electrical engineering and engineering management. He is the Principal Investigator on several current research projects and has supervised over 50 masters and doctoral candidates for degrees in both electrical engineering and engineering management. [etemadi@gwu.edu]

Dr. John Kamp—John Kamp received a Doctor of Engineering degree in engineering management from the George Washington University. Kamp teaches masters-level courses in project and program management and is a faculty Graduate Research Advisor in the School of Engineering and Applied Sciences. He is a retired Naval Submarine Officer with extensive experience in research and development and program management. His research interests include engineering management, maritime systems, and acquisition system research. Kamp is a Fellow in the Royal Institution of Naval Architects and a member of several professional associations. [jckamp2018@gwu.edu]

Abstract

How can we tell if policy innovations such as Middle Tier Acquisitions are working as intended? This research uses publicly-released data consisting of budget submissions, program-related reporting, and contemporaneous press releases to describe how the services are using Middle Tier Acquisition authorities to accelerate system innovation. Project schedule durations and intervals between significant events are used as indicators of significant schedule innovations. Middle Tier Acquisition programs have development times like other acquisition programs, but are much faster than other acquisition processes in going from initiation to development start and from design review to fielding of a prototype or capability.

Research Issue Statement: This research examines how Middle Tier Acquisition policy innovations affected acquisition system schedule performance relative to traditional major defense acquisition programs.

Research Results Statement: This research provides quantitative assessments of the effects of Middle Tier Acquisition policy innovations on project strategies and schedules.

Keywords: Middle Tier Acquisition, Defense acquisition, innovation

Introduction

This paper reports results from research considering three specific statutory changes intended to speed delivery of new capabilities and products: modular development, Agile development, and Middle Tier Acquisitions. Major defense acquisition programs (MDAPs)[1] take about eight years to proceed from program initiation to an initial operational capability, which is longer than adversaries need to create new problems for operational military forces.

Research Scope

The research applies to Department of Defense (DoD) acquisition program innovations, including g modular development, Agile development, and middle tier acquisition (MTA) programs, and specifically excludes programs intended to acquire services or Defense business systems. This research included acquisition policy and management changes enacted in the 2016, 2017, and 2018 National Defense Authorization Acts (NDAAs) and the DoD and service guidance, governance, and execution strategies implementing these changes. The research findings may not be valid for other system commodity types such as ships or ground vehicles or for acquisition practices outside the considered set of innovations.

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[1] See 10 U.S.C. 2430 for an explicit MDAP definition (10 USC 2430, 2021).

Research Questions and Objectives

RQ1. What programmatic attributes differentiate Major Capability Acquisitions and Middle Tier Acquisitions?

RQ2. What programmatic attributes differentiate Middle Tier Acquisitions from other rapid acquisition approaches?

RQ3. What programmatic attributes differentiate Middle Tier Acquisitions and commercial New Product Development?

Research Objective: to examine how public policy innovations directly related to DoD rapid acquisition strategies affected program performance and achieved intended policy outcomes.

Background/Literature Review

Innovation Definition and Measurement

The Organization for Economic Cooperation and Development (OECD) defines innovation as “a new or improved product or process (or combination thereof) that differs significantly from the unit’s previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)”(OECD, 2019).

Patent grants are a common measure of innovation (OECD, 2019). Table 1 summarizes patents from government contracts and grants between 2000 and 2013.

Table 1. Patent Percentages from Government Awards (2000–2013)

Type award	DoD	DOE	Other
Contract	15%	12%	2%
Grant	9%	6%	57%

Based on data from (de Rassenfosse et al., 2019).

Most patents arising from government-funded research come from research grants. If patent grants are measuring innovation, the above results suggest that DoD programs in particular and government contracts in general are not innovative (de Rassenfosse et al., 2019).

Fagerberg considered National Innovation systems and showed that while they have different structures and dynamics, technological innovation is essential to economic growth, (Fagerberg, 2017). Caiazza noted governments may act to improve innovation diffusion, and identified supply-side, demand-side, and general barriers preventing diffusion from the innovator to the adopter (Caiazza, 2016). General innovation diffusion barriers are often cultural, legal, or economic barriers (Caiazza, 2016). In principle, few statutory barriers exist to DoD innovation. In practice, departmental and programmatic risk aversion (Lopez, 2021) and lack of urgency (Flournoy & Lyons, 2016) act as general barriers.

Supply-Side Barriers to DoD Innovation

Four broad trends in federal procurement suggest some supply-side barriers to innovation: Federal procurement spending, a shift in procurements from products to services, an increased contracted workforce, and geographic spend concentration (Taylor, 2019). Federal procurement spending, while growing overall, was increasingly a lower percentage overall of the federal budget; federal procurements are increasingly shifting from goods to services; an increasing reliance on contracted workforce; the increase in federal procurements in the District of Columbia-Maryland-Virginia region[2]; and the close interactions of firms with offices in the DMV region with Congress and the federal procurement system (Taylor, 2019). These trends may disrupt some existing suppliers of defense-unique products, suggesting an expanding market opportunity to not only create new products, but to change the associated acquisition processes. In particular, defense research and development is a service (General Services Administration, 2020), and subject to different parts of the Federal Acquisition Regulations (FAR) than products[3]; non-FAR authorities such as other transaction agreements (10 U.S.C. 2371, 1993) or us commercial-type acquisition methods and approaches such as Procurements for Experimental Purposes (10 USC 2373, 2015) may be used to acquire research and development services.

Lockhart advocated for open communications within the DoD and between the DoD and suppliers to improve innovation performance (Lockhart, 2018). This incentivizes the supply side to create a market for technology innovations and future sales. The Defense Innovation Unit is a different but complementary effort, outside the normal acquisition community[4], and provides market access and non-dilutive capital for non-traditional defense contractors (*DIU*, 2020). It is focused on transitioning commercial advanced technologies in specific domains to the DoD, and uses an extension of other transaction agreement authorities (NDAA, 2015, sec. 815) to fund development and transition (*DIU*, 2020).

Demand-Side Barriers to DoD Innovation

Defense demand-side innovation barriers include business processes and culture. In 2014, the Defense Business Board analyzed core DoD acquisition processes, and estimated the overhead costs of current processes, potential savings, and general recommendations on goals and processes for business process improvements (Defense Business Board, 2015). The Advisory Panel on Streamlining and Codifying Acquisition Regulations[5] provided extensive recommendations intended to accelerate acquisition processes by leveraging commercial marketplaces and processes, simplifying acquisition regulations, changing resource allocation processes, and improving the acquisition workforce (Drabkin et al., 2016)[6].

A key demand-side issue is being able to efficiently discover new innovations. Fleming and Sorenson treat invention as a complex search over technology domains, and found that the local search space size and interdependence are the most significant predictors of successful search (Fleming & Sorenson, 2001). Such search traditionally required engaged expertise to discover new opportunities; these searches were typically the domain of the government research and development communities. In 2015, the defense procurement and acquisition community comprised about 20% of the total civilian workforce; the Defense Business Board recommended overall workforce reductions and retention of non-specific expertise, freeing resources to buy more systems (Defense Business Board, 2015), but likely increasing demand-side barriers, as fewer defense personnel would be aware of and in a position to adopt new innovations.

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[2] Turkina et al. cite such geographic proximity or density as a factor in creating innovation clusters (Turkina et al., 2019).

[3] Research and development contracting regulations are in FAR part 35, acquisition exploratory and development contracting regulations are in FAR part 34 (General Services Administration, 2019).

[4] The Defense Innovation Unit has offices in Silicon Valley, Boston, Austin, and Chicago, and reports to the Undersecretary of Defense for Research and Engineering (USD(R&E)).

[5] Created by Congress, this temporary Panel was also known as the Section 809 Panel, in reference to the National Defense Authorization Act section that created the panel (NDAA, 2015),

[6] The DoD has implemented less than half the recommendations.

Demand-side barriers are also related to resource availability and liquidity. Congress created several funding processes designed to accelerate technology transitions from non-traditional performers and are posted in the Defense Innovation Marketplace (OUSD[R&E], 2020). For example, in 2011 Congress created the DoD Rapid Innovation Fund to accelerate small business technology transition to the DoD (NDAA, 2011). It was managed by staff within the Office of the Undersecretary of Defense for Research and Engineering (OUSD[R&E]), and structured to complement DoD small business innovative research programs by providing transition funding to move technology into operational use or to an acquisition program within 24 months (OUSD[R&E], 2020)[7]. Figure 1 summarizes small business innovative research data from 2010–2020.

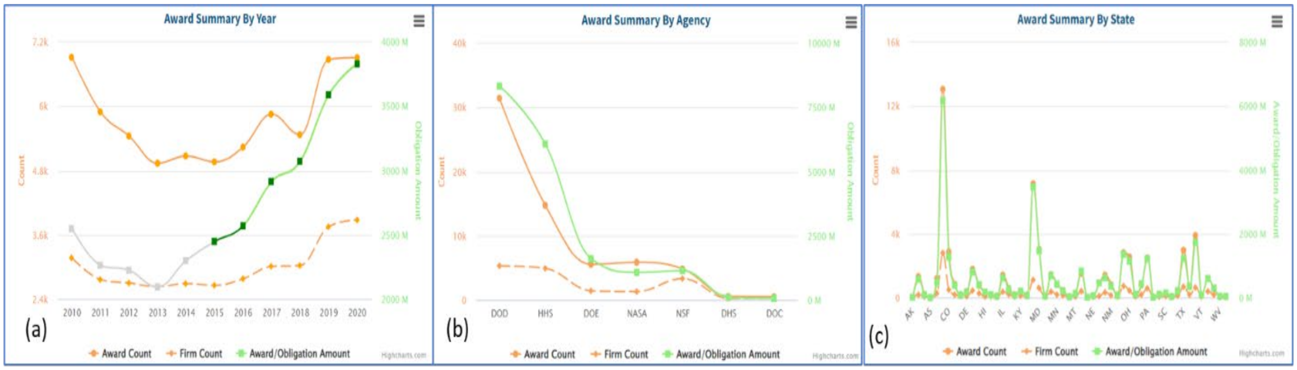

Figure 1. Small Business Innovative Research Summary, 2010–2020.
(sbir.gov. n.d.)

Figure 1a shows overall spending trends were roughly constant[8]. The DoD awarded most Small Business Innovative Research awards (Figure 1b), with most awards clustered in a few states, notably California, Massachusetts, Virginia, and Maryland (Figure 1c). Bresler noted that while the DoD has a long history of funding small, innovative companies, it generally does not provide follow-on business growth beyond initial sponsorship, reducing incentives for these companies to invest and remain in the defense market (Bresler, 2018). The conclusion is that small business research provides significant exposure to new ideas, but inefficient transition of innovations to product.

Kendall advocated structural and policy changes to control costs and to incentivize industry and government to adopt strategies such as increased use of prototypes and open system architectures[9] (Kendall, 2014). Such recommendations are both supply-side and demand-side, as suppliers are incentivized to create new products and buyers have increased exposure to new ideas and incentives to discover new products. Policies can also create disincentives. For example, DoD major automated information systems programs were required to report significant schedule growth to Congress (Cha, 2016), creating a strong incentive for schedule adherence[10], which tends to suppress seller innovation[11], and reduces incentives for opportunistic behaviors (Schoeni, 2018).

In 2016, Congress enacted Middle Tier Acquisition (MTA) processes enabling the Department of Defense (DoD) to prototype and field new capabilities within two to five years of approval (NDAA, 2015). Four statutory changes set the foundations for accelerating new

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[7] Congress did not appropriate funding for this activity in 2020 or later years.

[8] The average per award increase between 2010 and 2020 was about 3% per year.

[9] Cost control was to improve buying power; the strategy changes were to reduce technical barriers to innovation.

[10] Note that in 2015 MAIS programs had mean cycle times of about 3 years (Kendall, 2016)

[11] Schedule adherence pressure will incentivize using more products that are either in-use or commercial products.

capability development: 1) explicitly setting an objective duration; 2) providing explicit authority allowing service acquisition executives to bypass traditional requirements and acquisition processes[12]; 3) revising funding approval thresholds, authorities, and applicability criteria[13]; and 4) allowing direct transition to production under specific conditions[14]. Following Fagerberg, the schedule constraint provides a *demand* for new innovations, and the revised authorities provide *institutional* and *financial* capability to execute (Fagerberg, 2017). In 2018, Congress authorized a DoD Agile Pilot program[15] (NDAA, 2017). These innovations acted to *reduce innovation barriers*.

New Product Development and Time to Market

The commercial new product development process may inhibit supply for two reasons: profitability outside government procurement and significant process factors for commercial new product development. Braha and Bar-Yam modeled commercial new product development as a complex network. They found that such networks are responsive to design status changes, processes are bounded in their ability to process new inputs, and they hypothesized that information flows tend to follow system architectures (Braha & Bar-Yam, 2007).

Markham et al. looked at informal activities in new product development. Informal interactions between three roles—champion, sponsor, and gatekeeper—precede formal new product development and represent significant research and business activity (Markham et al., 2010). Breakdowns in these interactions create gaps between research and formal development called the “Valley of Death”; Bonnin Roca and O’Sullivan thought a major cause of this gap was a lack of investment to take a proof of concept to a prototype or commercialization, and pointed to regulatory uncertainty and technology immaturity as causes of this reluctance (Bonnin Roca & O’Sullivan, 2020). This gap can occur within an organization; Dean et al. note that organizational and product complexity, radical innovation performance and whether innovation occurs within a firm or cross firms matter (Dean et al., 2020).

Time to market is an important factor in commercial new product development. Browning and Yassine note that contrary to most of the literature and most models, product development is commonly cyclical (Browning & Yassine, 2016). They considered different program development policies (“priority rules”) for both cyclical and acyclical program and portfolios with varying degrees of resource contention, and derived a small set of priority rules for program offices to minimize average project or portfolio delay (Browning & Yassine, 2016). Evans and Johnson developed an ordinal “innovation readiness level” (IRL) scale, providing a supplier view of innovation that included business outcomes such as beta version sales and cash-positive operations, and considered other factors such as human resources, legal, and financial readiness in their overall model; they did not, however, address time to market (Evans & Johnson, 2013).

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[12] Such as establishing direct-reporting program managers for these rapid acquisition programs (NDAA, 2015).

[13] Section 815 approval authorities were modified to allow “The senior procurement executive for the agency determines in writing that exceptional circumstances justify the use of a transaction that provides for innovative business arrangements or structures that would not be feasible or appropriate under a contract, or would provide an opportunity to expand the defense supply base in a manner that would not be practical or feasible under a contract.” (NDAA, 2015).

[14] This is allowed provided competitive procedures were used in the original award and the contractor successfully completed the prototype project (NDAA, 2015)

[15] Fifteen programs were inducted into the pilot; best practices are summarized in the Agile Software Acquisition Guidebook (Cummings, 2020).

Sherman and Rhoades noted that incentives and sanctions have to be aligned to favor cycle time reduction and provide historical government and industry examples (Sherman & Rhoades, 2010). For example, urgent acquisition programs may have broad exemptions from established statutory and regulatory controls (NDAA, 2015, sec. 803). They benefit from access to additional resources and support (Lord, 2020), which are strong incentives for government entities to find new innovations. Acquisition schedules[16] between 1997 to 2015 averaged about seven years in duration (Kendall, 2016). Several factors are related to faster defense acquisitions, such as need urgency and senior leader sponsorship (Van Atta et al., 2016); using proven systems (Tate, 2016), using non-waterfall software development methods and adapting commercial technologies (A. Etemadi & Kamp, 2021), and organizational planning and execution competence (Jaifer et al., 2020). We previously showed how suppliers in defense-unique markets are not incentivized to shorten schedule duration (A. H. Etemadi & Kamp, 2021).

Conclusions and Research Hypotheses

There are several barriers to innovation within the DoD. Traditional processes that worked well when the DoD held the largest market share now must compete for performers when commercial markets provide greater economic incentives. Congress intended Middle Tier Acquisitions to deliver prototypes or fielded systems within five years of program start (NDAA, 2015). They inserted several incentives encouraging DoD use such as reduced requirements, broader authorities, and access to resources. Our research hypothesis is that *Middle Tier Acquisition programs have shorter schedule durations than other rapid acquisition approaches*.

The next section of this paper discusses the research methodology and datasets. The paper continues with a discussion of results and conclusions.

Methodology

Schedule growth is problematic given the emphasis on shorter durations. There are two types of Middle Tier Acquisitions—rapid prototyping and rapid fielding. Figure 2 provides an example program schedule plan.

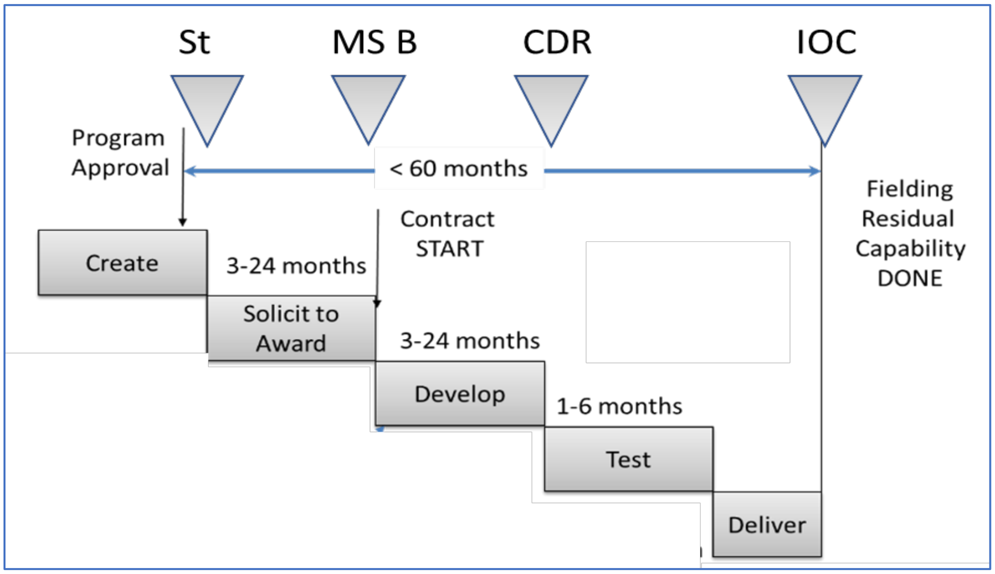

Figure 2. Middle Tier Acquisition Rapid Prototyping Schedule Model

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[16] Often called cycle time in the literature.

Figure 2 shows four gates or milestones—program approval or start (St), development start (MS.B), design review (CDR), and delivery (IOC). The durations and events in Figure 2 are notional, and may be changed to meet programmatic objectives. This model has three *intervals* or *phases*—the time between approval and development start (St.B), the time from development start to design review (B.CDR), and the time from design review to delivery (CDR.IOC). Schedule growth may occur during one or more of these intervals. Table 2 shows common causes of schedule growth in each interval.

Table 2. Interval Schedule Definitions and Literature Growth Causes

Interval	Causes for Schedule Growth	Reference
Approval to development start (St.B)	Contracting issues	(Riposo et al., 2014) (Asadabadi & Sharpe, 2019)
Development start to design review (B.CDR)	Technology maturity Requirements uncertainty	(Katz et al., 2015) (Fernandes et al., 2015)
Design review to delivery (CDR.IOC)	Integration and test issues	(Manuel, 2019)

We used interval duration changes as a proxy for process innovation. This provided insight into not only overall process change but where improvements occurred.

We used publicly available data sources for this research: General Accountability Officer (GAO) annual weapon system assessments, released Selected Acquisition Reports (SARs), Director, Operational Test and Evaluation (DOTE) Annual Reports, and data from FPDS.gov and usaspending.gov websites. We created a dataset using the 2020 GAO annual weapon system assessment (n= 63; Dodaro, 2020), and eliminated entries with insufficient data or changing structures, leaving 53 entries. Table 3 summarizes the dataset.

Table 3. Selected GAO 2020 Programs

Type	AIR	C3I	GND	MSL	SHIP	SPACE
MCA	APT	AMDR	**ACV**	AARGM-ER	**CVN78**	WSF
	B2DMSM	**HMS**	AMPV	***SDB.INC2***	**DDG1000**	
	CIRCM	***OCX.BLK1.2***		**JAGM**	**FFGX**	
	CRH	***JPALS***		**IFPC.Inc2**	**SSBN826**	
	F15EPAWSS	***IAMD***		PrSM	**SSC**	
	CH-53K				TAO205	
	KC46A				**DDG51FLT3**	
	IRST.BLK2				LHA8	
	UH-1N.REP				LPD17	
	MQ25				**SSN774.BLK5**	
	MQ4C					
	NGJ-MB					
	ITEP					
	VC25.RECAP					
	VH92					
	B52RMP					
	P8A.INC3					
	F35					
MTA	**B52CERP**	**LTAMDS**	***ERCA.Inc1C***	*ARRW*		*OPIR.BLK0*
	F22CP	*UP*	***IVAS***	HCSW		*PTES*
			MPF			*PTS*
Coding	No code	*Agile*	**Modular**	***Agile+Modular***		

The program types are Major Capability Acquisition[17] (MCA) and Middle Tier Acquisition (MTA; Lord, 2020). The columns sort the programs into commodity types. The programs were coded as modular or Agile development based on review of the public reports. Contract data was substantial, programmatic data sparse. We manually validated the dataset[18]. We compared program types by coding using graphical methods. Descriptive statistics and quantitative tests were used to quantify and confirm significance for sufficient populations, and we used Mood's Median Test to test the research hypothesis. The next section presents the analysis results.

Results And Analysis

We sorted the programs by MCA or MTA and by coding as an Agile or Modular development program. We start by comparing start phase durations between different program types. Figure 3 shows the 2020 start phase (St.B) intervals for all MCAs and MTAs, and the cumulative distribution of St.B for modular and Agile MCA developments.

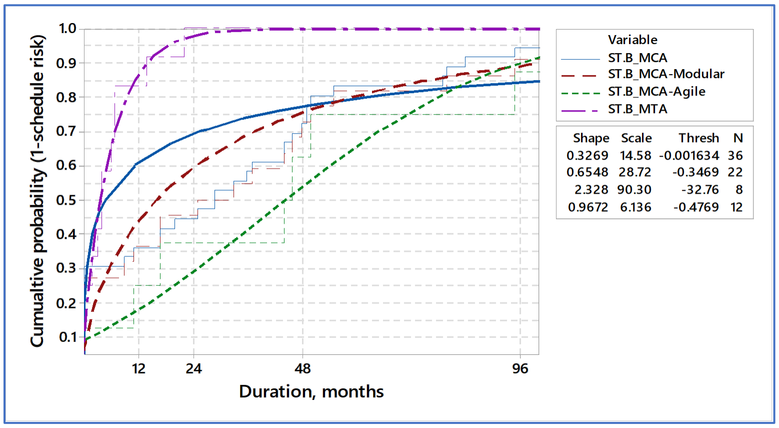

Figure 3. Start Intervals.
(GAO, 2020).

The interval between program start and development start St.B depends on the source selection and award process. Note that half of the MCA programs achieved Milestone B within 12 months, while about half of MTAs achieved Milestone B in less than six months. A Mood's median test shows MTA start intervals are statistically different ($\chi^2 = 10.52$, p-value = 0.018) than the start interval medians of the various types of MCAs. Therefore, the MTA solicitation and awards process is different than traditional processes as MTAs are more likely than MCAs at awarding contacts in less than 12 months. Table 4 shows modular program phase statistics.

Table 4. Modular Program Interval Durations Summary.
(GAO, 2020).

		Modular					Non-modular				
Interval	**Type**	**N**	**N***	**Mean**	**StDev**	**Median**	**N**	**N***	**Mean**	**StDev**	**Median**
ST.B	MCA	22	2	35.55	35.54	29	14	3	29.93	28.92	29
	MTA	5	0	3.6	6.07	0	7	0	7.29	6.78	6
B.CDR	MCA	19	5	28.42	27.33	21	17	0	23.94	18.04	18
	MTA	2	3	16.5	10.61	16.5	3	4	22.33	13.05	18
CDR.IOC	MCA	18	6	89.78	35.98	88	17	0	67.76	20.95	59
	MTA	2	3	43.5	10.61	43.5	3	4	34	12.77	31

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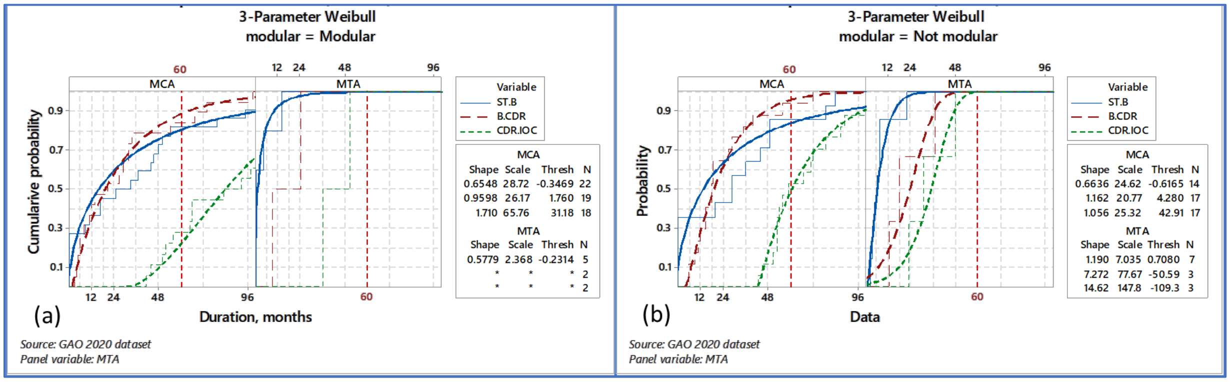
[17] This is also known as a Major Defense Acquisition Program (MDAP).

[18] In some cases, policy delayed public release.

The small populations make graphical analysis more insightful, and quantitative analysis less meaningful. Figure 4 shows the program intervals for modularity-coded MCAs and MTAs.



Source: GAO 2020 dataset
Panel variable: MTA

Source: GAO 2020 dataset
Panel variable: MTA

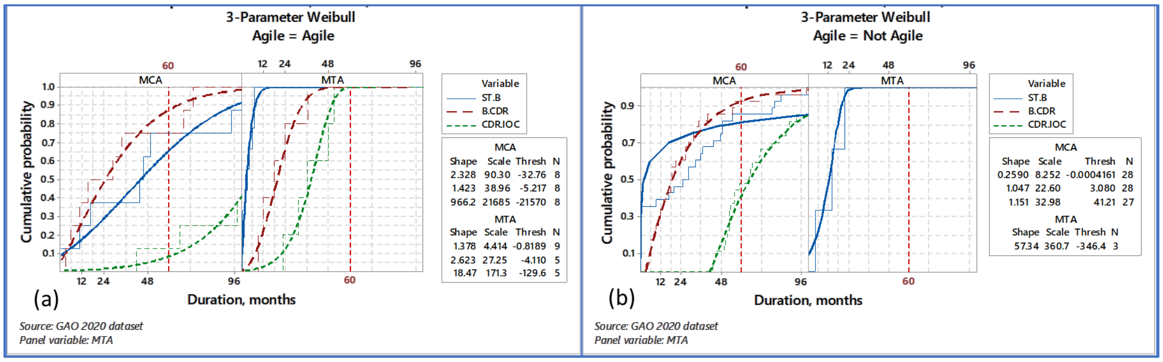
Figure 4. Modular Development Inter-Event Durations, Weibull Distribution

Figure 4a shows the modular-coded program phase results, and Figure 4b shows the non-modular coded phase results. Modular MCA CDR.IOC phases are longer than the first two phases, and that MTA start phase is fast relative to an MCA. No useful qualitative results can be drawn for B.CDR and CDR.IOC for modular-coded MTAs. For non-modular coded programs, the MTA St.B phase looks similar to the modular programs. The non-modular B.CDR and CDR.IOC phases complete sooner than for non-modular MCAs. However, non-modular development (B.CDR) MCA and MTA phases are closer in duration, with more than 90% of all programs completing B.CDR in less than 48 months. Table 5 shows Agile program phase statistics for both program types.

Table 5. Agile Program Interval Durations Summary. (GAO, 2020).

		Agile					Non-Agile				
Interval	**Type**	**N**	**N***	**Mean**	**StDev**	**Median**	**N**	**N***	**Mean**	**StDev**	**Median**
ST.B	MCA	8	1	46.9	39.6	45	28	4	29.5	30.33	27
	MTA	9	0	3.222	2.95	3	3	0	13.33	9.02	14
B.CDR	MCA	8	1	30	27.49	22	28	4	25.25	22.28	18.5
	MTA	5	4	20	11.11	18	0	3	*	*	*
CDR.IOC	MCA	8	1	101.3	32.2	111.5	27	5	72.52	28.37	65
	MTA	5	4	37.8	11.69	36	0	3	*	*	*

Figure 5 shows Agile-coded program intervals.



Source: GAO 2020 dataset
Panel variable: MTA

Source: GAO 2020 dataset
Panel variable: MTA

Figure 5. Agile-Inter-Event Durations, Weibull Distribution

The Agile-coded MCA start (St.B) phases were slower than their development (B.CDR) phases. Non-Agile MTAs did not have a specified design review, so they have a different program structure than the Agile-coded MTAs. These are all summarized in Table 6.

Table 6. Overall Program Interval Duration Summary.
(GAO, 2020).

				Overall		
Interval	Type	N	N*	Mean	StDev	Median
St.B	MCA	36	5	33.36	32.81	29
	MTA	12	0	5.75	6.48	4
B.CDR	MCA	36	5	26.31	23.19	18.5
	MTA	5	7	20	11.11	18
CDR.IOC	MCA	35	6	79.09	31.28	67
	MTA	5	7	37.8	11.69	36

The overall statistics are reasonable for comparing groups. Note that median St.B and CDR.IOC durations are smaller for MTAs than for MCAs, while B.CDR durations are similar. No Agile-coded MTA programs had identified design reviews. Figure 6 compares the different phase cumulative distributions.

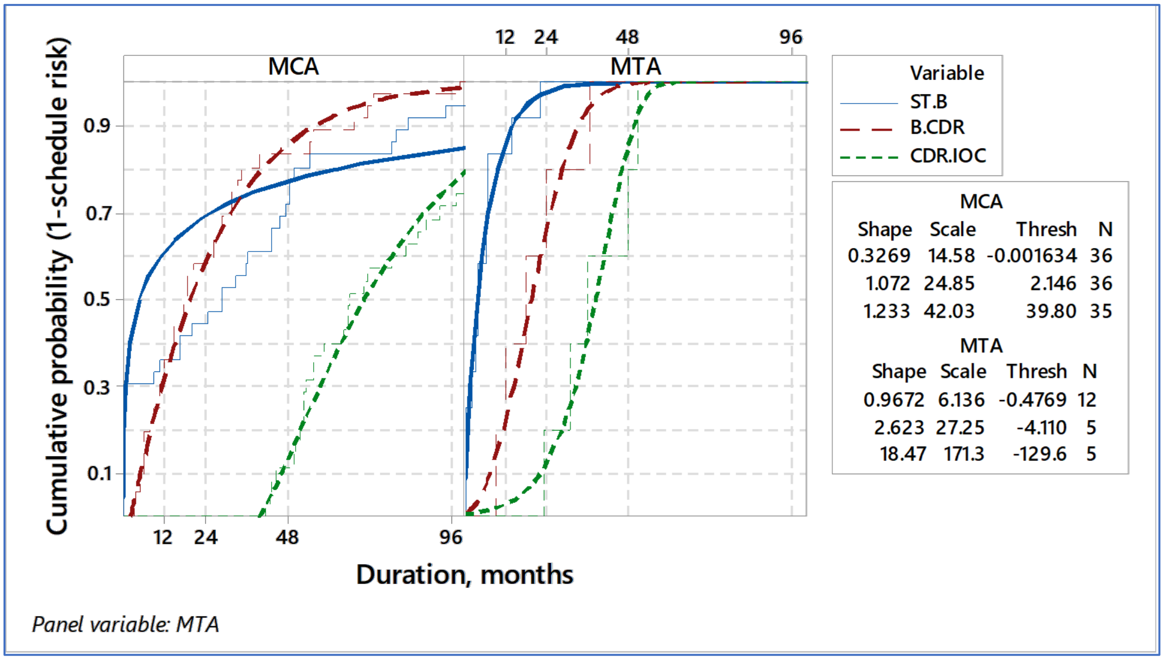


Figure 6. Overall Interval Cumulative Distributions

The figure shows the much faster start (St.B) and delivery (CDR.IOC) phases of MTAs relative to traditional programs. It also shows that the development (B.CDR) phases are similar, again with more than 90% of all programs completing design review within four years of development start. It also shows that for an MTA to achieve its objective of delivery within 60 months of start, it must have a very fast (less than three month) start (St.B) phase, a development phase of less than two years, leaving the remainder of about three years for delivery. About four in 10 (about 40%) of MTAs could achieve these goals assuming serial phases. Table 7 looks at how phase durations correlated with prior significant cycle time predictor variables (A. H. Etemadi & Kamp, 2021).

Table 7. Factor Correlations.
(GAO, 2020).

	Interval or factor	St.B	A	B	C	D	E	F	G	H
A	B.CDR	--								
B	CDR.IOC	--	**0.41							
C	Cycle time, months	***0.55	**0.42	***0.78						
D	R&D Budget	*0.27	*0.30	*0.35	***0.50					
E	% Change in (D)	*0.31	--	**0.50	***0.59	*0.34				
F	Budget Importance	--	*0.27	***0.68	***0.67	***0.53	*0.29			
G	Unit cost	--	*0.33	--	*0.32	--	--	--		
H	% change in buy	*-0.25	--	*0.29	--	*-0.30	**-0.41	--	--	
I	% change in (C)	--	--	***0.50	***0.51	--	***0.64	*0.24	--	--

*p-values *0.xxx - < 0.1 **0.xxx - < 0.01 ***0.xxx - <0.001*

Negative correlations in Table 7 are in ***bold italics***. Table 7 shows that interval durations correlated with research and development budgets, because major program overall schedule are correlated with these factors. *No correlations with prior significant MCA predictor variables were found for an MTA-only dataset*[19]. Finally, we used Mood's Median Test to test if medians were statistically different between MCA and MTA program phases. Table 8 shows the results of this testing.

Table 8. Mood's Median Test Summary

	Group	Median	N <= Overall	N > Overall	Q3 – Q1	95% Median CI	DF	X^2	P-Value
St.B	MCA	29	13	23	49	(10.5, 44.5)	1	11.11	**0.001**
	MTA	4	11	1	6.5	(0.5, 7)			
	*Overall	15.5							
B.CDR	MCA	18.5	18	18	24	(12, 29)	1	0.18	0.675
	MTA	18	3	2	20	(9, 37)			
	*Overall	18							
CDR.IOC	MCA	67	15	20	55	(56, 88.3905)	1	5.71	**0.017**
	MTA	36	5	0	22.5	(23, 51)			
	*Overall	65.5							

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[19] See Appendix for details.

Two phase intervals were statistically different—the start (St.B) and the deployment (CDR.IOC) phases. The test did not find a significant difference in the development (B.CDR) phase.

Conclusions

All research questions were addressed. Middle Tier Acquisitions have significantly shorter start (St.B) and deployment (CDR.IOC) phases than Major Capability Acquisitions. Additionally, there were no correlations between Middle Tier Acquisitions phase durations and known correlates with Major Capability Acquisitions. These phase differences are due to using acquisition authorities such as commercial-like contracting methods[20], acquisition tailoring, and limited production runs to satisfy delivery definitions. While MTAs may include modular or Agile development methods or principles, the statutes incentivize limiting explicit requirements, delivered quantities, and testing activities. The technical risk of MTA programs is implicitly limited by the statutory duration limit, incentivizing program offices and contractors towards technologies and products deliverable within this limit. Commercial New Product Development technical risk constraints are similarly driven by time-to-market and budget limits, but the motivation is profit or loss instead of statutory limits.

Middle Tier Acquisition programs *have shorter schedule durations than other rapid acquisition approaches (research hypothesis).* Modular development schedules may be longer than other equivalent programs due to testing and validating the modular interfaces and interactions. Following initial delivery, subsequent changes may be less complex. Agile development moves quickly, but MTAs have an explicit transition to sustainment which makes the MTA deployment phase faster.

The Middle Tier Acquisition pathway provides structural incentives for programs to deliver capabilities in a short period of time. They complement existing rapid acquisition processes and highlight the importance of aligning incentives and objectives.

Future research should revisit the FY 2020 Middle Tier Acquisitions and confirm or refute predicted outcomes. Access to non-public information such as program strategies and surveys of program office personnel would illuminate the underlying decisions and trades made for different types of rapid acquisition programs.

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[20] Such as 10 USC 2371b (Other Transaction Agreements) and 10 USC 2373 (Procurements for Experimental Purposes).

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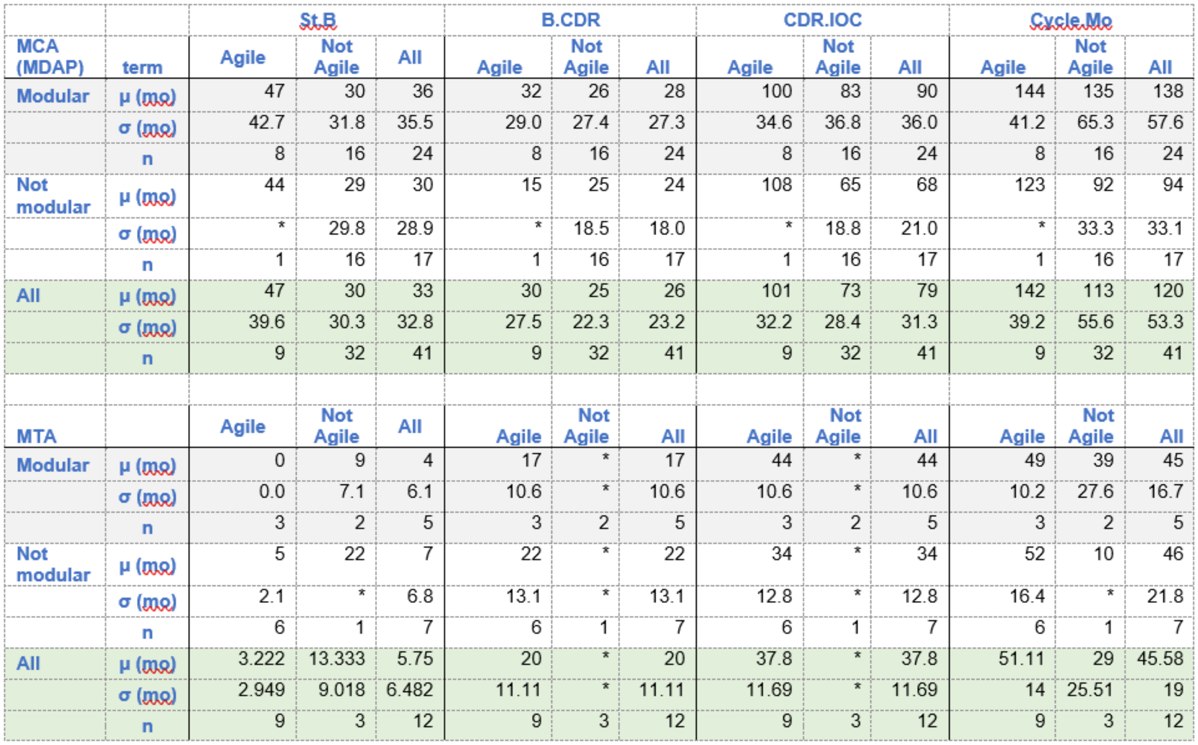
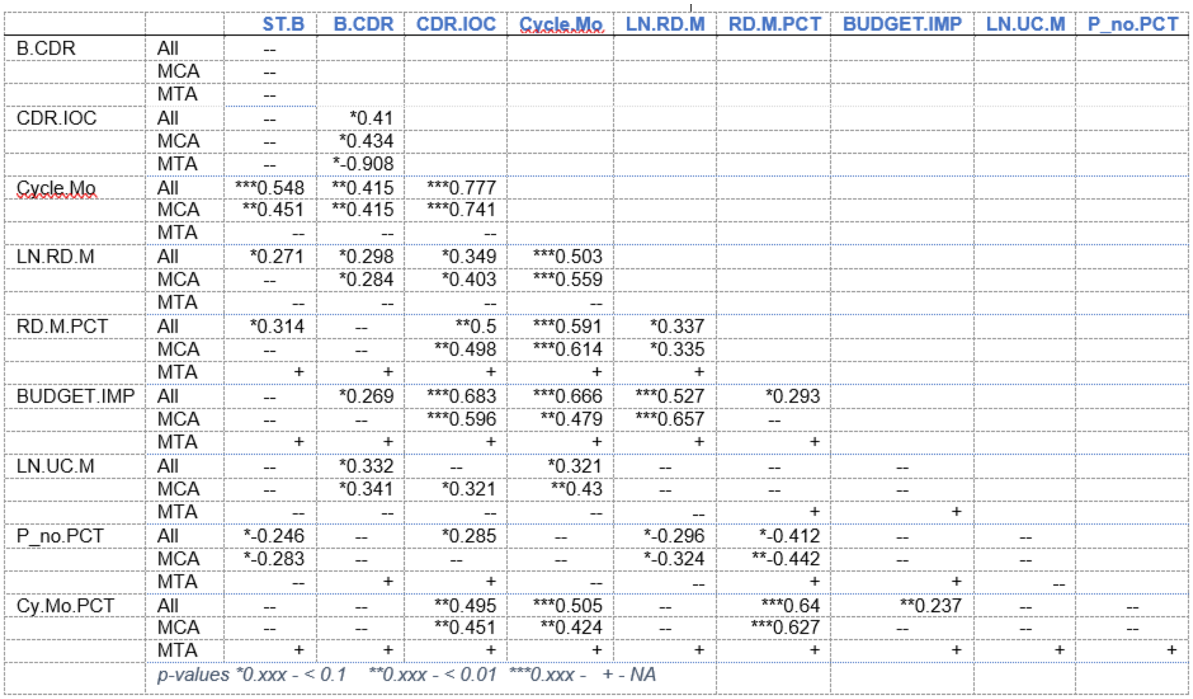
Appendix

Table 9. Dataset Summary (N=53).
(GAO, 2020).



		St.B			B.CDR			CDR.IOC			Cycle.Mo		
MCA (MDAP)	**term**	**Agile**	**Not Agile**	**All**	**Agile**	**Not Agile**	**All**	**Agile**	**Not Agile**	**All**	**Agile**	**Not Agile**	**All**
Modular	**μ (mo)**	47	30	36	32	26	28	100	83	90	144	135	138
	σ (mo)	42.7	31.8	35.5	29.0	27.4	27.3	34.6	36.8	36.0	41.2	65.3	57.6
	n	8	16	24	8	16	24	8	16	24	8	16	24
Not modular	**μ (mo)**	44	29	30	15	25	24	108	65	68	123	92	94
	σ (mo)	*	29.8	28.9	*	18.5	18.0	*	18.8	21.0	*	33.3	33.1
	n	1	16	17	1	16	17	1	16	17	1	16	17
All	**μ (mo)**	47	30	33	30	25	26	101	73	79	142	113	120
	σ (mo)	39.6	30.3	32.8	27.5	22.3	23.2	32.2	28.4	31.3	39.2	55.6	53.3
	n	9	32	41	9	32	41	9	32	41	9	32	41
MTA		**Agile**	**Not Agile**	**All**	**Agile**	**Not Agile**	**All**	**Agile**	**Not Agile**	**All**	**Agile**	**Not Agile**	**All**
Modular	**μ (mo)**	0	9	4	17	*	17	44	*	44	49	39	45
	σ (mo)	0.0	7.1	6.1	10.6	*	10.6	10.6	*	10.6	10.2	27.6	16.7
	n	3	2	5	3	2	5	3	2	5	3	2	5
Not modular	**μ (mo)**	5	22	7	22	*	22	34	*	34	52	10	46
	σ (mo)	2.1	*	6.8	13.1	*	13.1	12.8	*	12.8	16.4	*	21.8
	n	6	1	7	6	1	7	6	1	7	6	1	7
All	**μ (mo)**	3.222	13.333	5.75	20	*	20	37.8	*	37.8	51.11	29	45.58
	σ (mo)	2.949	9.018	6.482	11.11	*	11.11	11.69	*	11.69	14	25.51	19
	n	9	3	12	9	3	12	9	3	12	9	3	12

Table 10. Interval and Factor Pearson Correlations (n=53).
(GAO, 2020).



		ST.B	B.CDR	CDR.IOC	Cycle.Mo	LN.RD.M	RD.M.PCT	BUDGET.IMP	LN.UC.M	P_no.PCT
B.CDR	All	--								
	MCA	--								
	MTA	--								
CDR.IOC	All	--	*0.41							
	MCA	--	*0.434							
	MTA	--	*-0.908							
Cycle.Mo	All	***0.548	**0.415	***0.777						
	MCA	**0.451	**0.415	***0.741						
	MTA	--	--	--						
LN.RD.M	All	*0.271	*0.298	*0.349	***0.503					
	MCA	--	*0.284	*0.403	***0.559					
	MTA	--	--	--	--					
RD.M.PCT	All	*0.314	--	**0.5	***0.591	*0.337				
	MCA	--	--	**0.498	***0.614	*0.335				
	MTA	+	+	+	+	+				
BUDGET.IMP	All	--	*0.269	***0.683	***0.666	***0.527	*0.293			
	MCA	--	--	***0.596	**0.479	***0.657	--			
	MTA	+	+	+	+	+	+			
LN.UC.M	All	--	*0.332	--	*0.321	--	--	--		
	MCA	--	*0.341	*0.321	**0.43	--	--	--		
	MTA	--	--	--	--	--	+	+		
P_no.PCT	All	*-0.246	--	*0.285	--	*-0.296	*-0.412	--	--	
	MCA	*-0.283	--	--	--	*-0.324	**-0.442	--	--	
	MTA	--	+	+	--	--	+	+	--	
Cy.Mo.PCT	All	--	--	**0.495	***0.505	--	***0.64	**0.237	--	--
	MCA	--	--	**0.451	**0.424	--	***0.627	--	--	--
	MTA	+	+	+	+	+	+	+	+	+
	*p-values *0.xxx - < 0.1 **0.xxx - < 0.01 ***0.xxx - + - NA*								

Acquisition Research Program
Naval Postgraduate School
555 Dyer Road, Ingersoll Hall
Monterey, CA 93943

www.acquisitionresearch.net