INNOVATION AND MIDDLE TIER ACQUISITIONS

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Grant : HQ00342010010

Period of Performance: 22 May 2020 – 31 July 2021

May 13, 2021

This material is based upon work supported by the Acquisition Research Program under Grant No. 12936478. The views expressed in written materials or publications, and/or made by speakers, moderators, and presenters, do not necessarily reflect the official policies of the Department of Defense nor does mention of trade names, commercial practices, or organizations imply endorsement by the U.S. Government.

Research questions

What programmatic attributes differentiate Middle Tier Acquisitions and

- Major Capability Acquisitions
- other rapid acquisition approaches
- commercial New Product Development?

- Types of acquisitions
  - Middle Tier Acquisitions (MTAs)
  - Major Capability Acquisitions (MCA)
  - Programs cited as “Agile” development
  - Programs with “Modular” architectures

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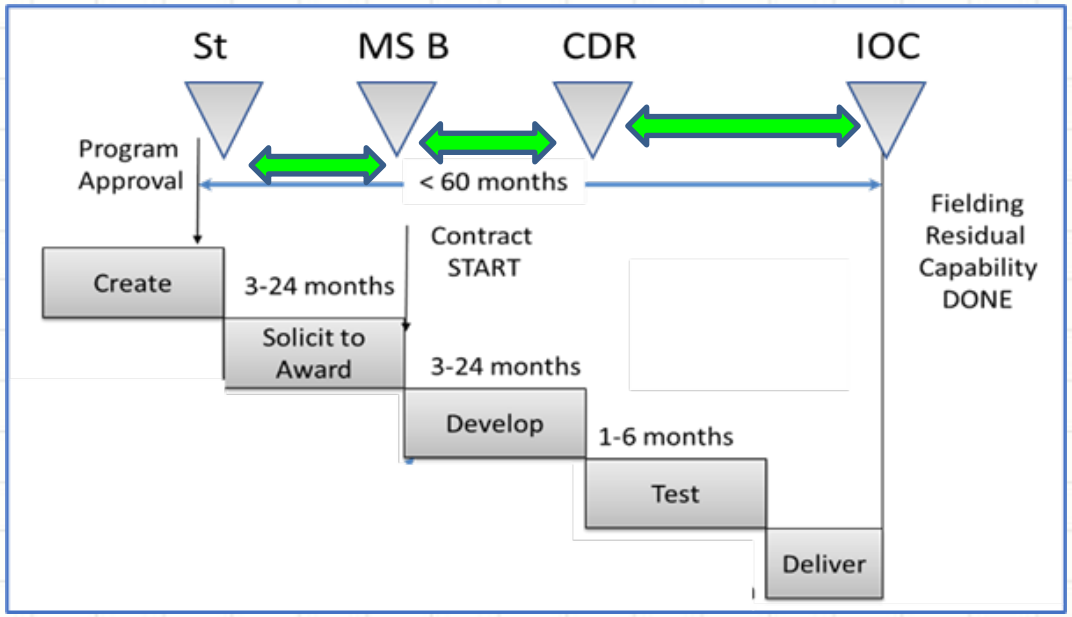
Research issue and methodology

- How public policy innovations directly related to DoD rapid acquisition strategies affected program performance and achieved intended policy outcomes

- Methodology
  - Literature review
  - Gather budget
  - Use common gates
  - Compare between-gate durations



Interval	Causes for schedule growth
Approval to development start (St.B)	Contracting issues
Development start to design review (B.CDR)	Technology maturity Requirements uncertainty
Design review to delivery (CDR.IOC)	Integration and test issues

Types of programs delivering prototypes or fielded systems ≤ 5 years

- Sub-system prototypes
  - 2019 Navy established new program element(PE 0604030N)
  - Rapid Prototyping, Experimentation and Development (RPED)
- Rehost existing systems into commercial containers
  - Expeditionary Integrated Undersea Surveillance System (IUSS)
- SM-6 Block 1B – booster prototype
  - Missile in production since 2009
  - 2 year booster development and test
  - Transition to maturation and future technology insertion

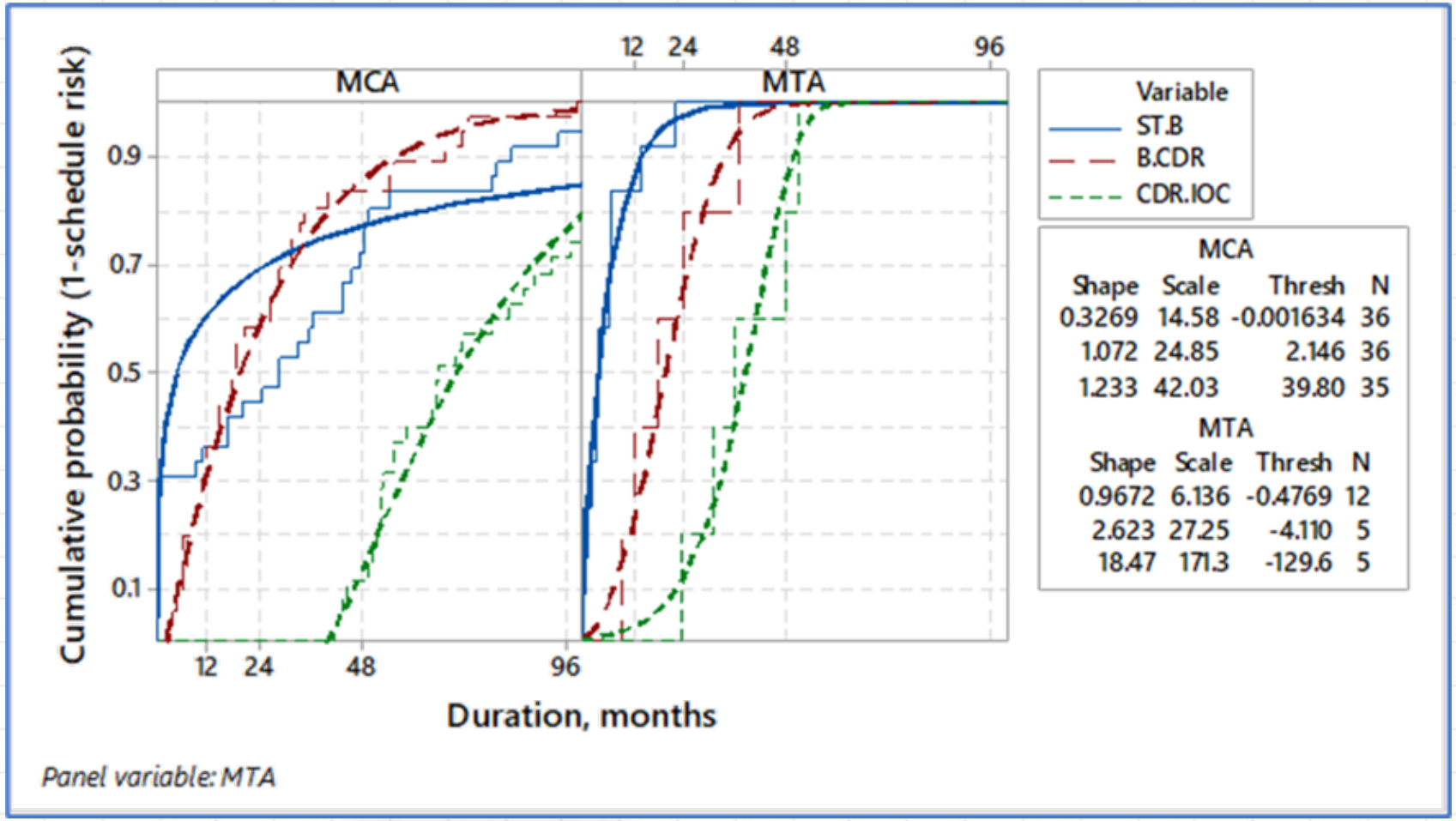
Comparing MCA and MCA intervals

MTA Faster

- Time to contract award
- Time from design review to completion

Medians ~ same

- Development time (to design review)



Qualitative comparison of MTA intervals to other approaches

	Modular MCA vs MTA	Agile MCA vs MTA	MCA vs MTA
St.B	Longer (~ 29 vs ~ < 3 months)	Longer (~ 45 vs ~ 3 months)	Longer (~ 29 vs ~ 4 months)
B.CDR	Longer (~ 21 vs ~ 16 months)	Longer (~ 22 vs ~ 18 months)	similar (~ 18.5 vs ~ 18 months)
CDR.IOC	Longer (~ 88 vs ~ 44 months)	Longer (~ 111 vs ~ 36 months)	Longer (~ 67 vs ~ 36 months)

Small MTA populations – statistics are unreliable

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MTAs are different

- MTA s use
  - acquisition authorities such as commercial-like contracting methods
  - acquisition tailoring, and
  - limited production runs to satisfy delivery definitions
- MTAs
  - may include modular or Agile development methods or principles
  - Technical risk is implicitly limited by the statutory duration limit

- Statutes incentivize
  - limiting explicit requirements, delivered quantities, and testing activities
  - program offices and contractors towards technologies and products deliverable within MTA schedule limits
- Commercial New Product Development
  - motivation is profit or loss instead of statutory limits
  - technical risk constraints are driven by time-to-market and budget limits

Summary - MTA innovations and practical applications

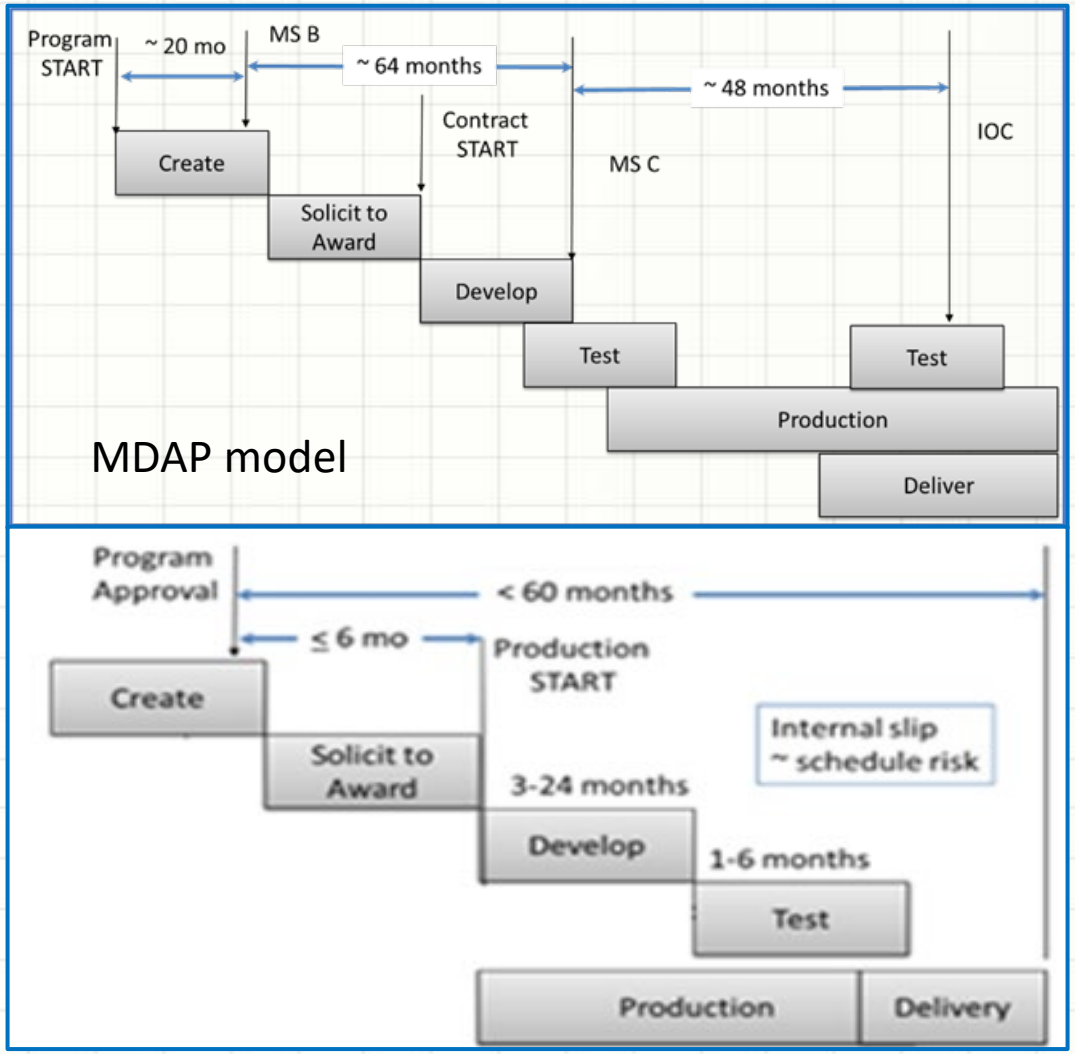
MTA Innovations	Practical applications
• Explicitly setting an objective duration	• Reduce TECHNICAL goals to meet window • Bound development by what is known and in use – including interfaces and standards • Segment integration risk
• Allowing service acquisition executives to bypass traditional requirements and acquisition processes • Revising funding approval thresholds, authorities, and applicability criteria • allowing direct transition to production under specific conditions	• Have sponsorship from the top and use the flexibility to overcome inevitable obstacles. • Resource availability – incentive • Speed to award • Have a competent team (Gov't, Contractor, user) • Minimize production learning curve delays

Backup

Approaches that fielded products in ≤ 5 years

- Existing ("hot") production line
  - Commercial product
  - Conversion of older platforms to new use
  - QF-16 – drone from retired aircraft
- Different contract/award models
  - Skyborg Prototypes – 24 months
  - Next generation squad weapon – Other Transaction
- Modularization
  - Costs carried by larger project
  - F-16 radar upgrade
- Existing Open host platform architecture + software update
  - F-16 M7.2+ Operational Flight Program

Comparing profiles



What budget data shows about rapid programs

- Built database (mostly AF) on FY 2020-2021 data (57 entries)
- Very few Middle Tier acquisition comments prior to 2020
  - Evolutionary and incremental acquisitions
  - Some modularity
  - Some rapid acquisition
- Kruskall-Wallis tests of median schedules

Type	Significant
Rapid Prototyping	No
Rapid Fielding	Yes
Agile	Yes
Modular	

Schedule risk by Agility code

TYPE	P(≤60 Mo)	~Risk (> 60 Mo)
Agile	24%	76%
Not AGILE	27%	73%

Test

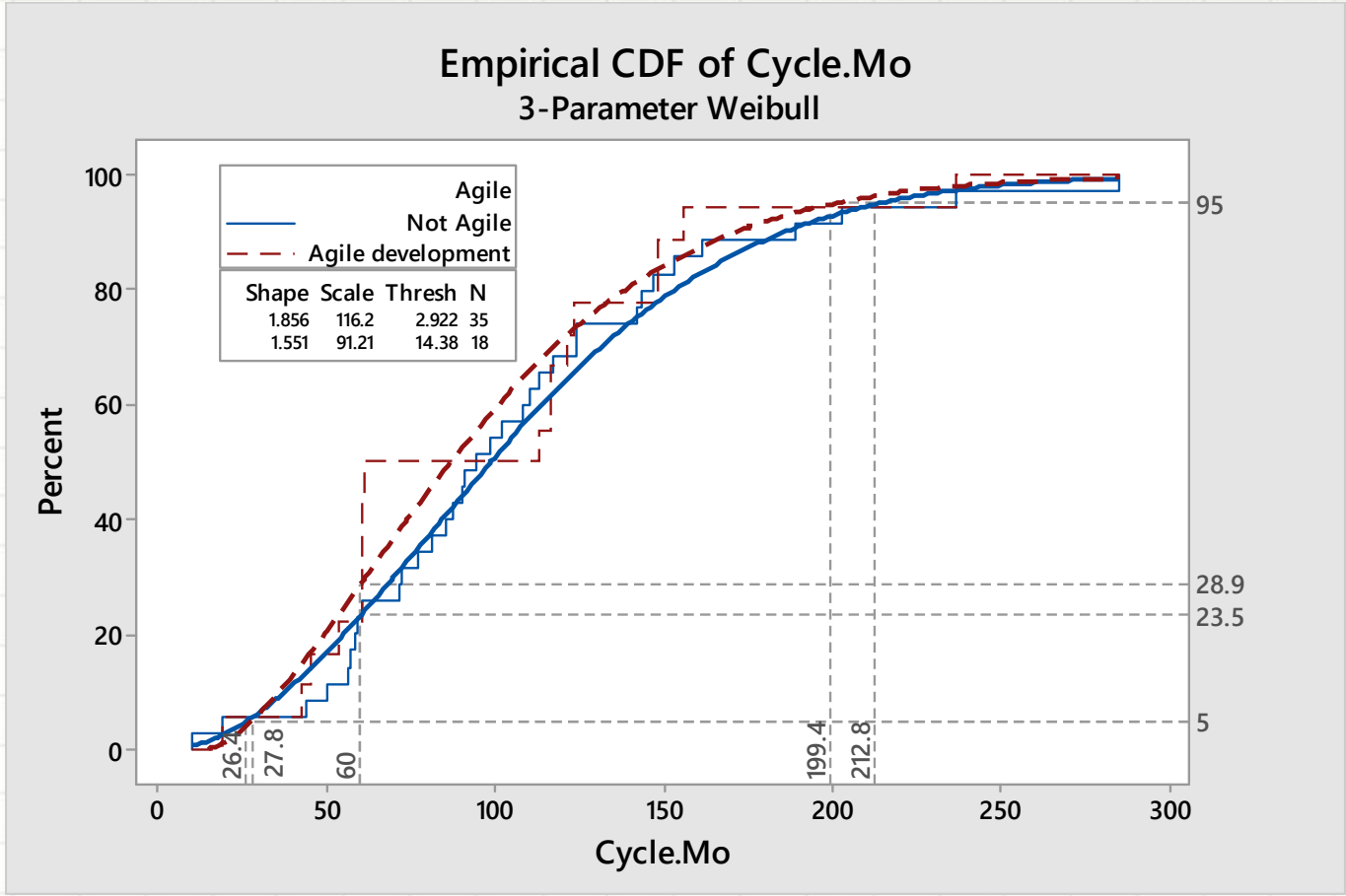
Null hypothesis	H_0: The population medians are all equal
Alternative hypothesis	H_1: The population medians are not all equal

DF	Chi-Square	P-Value
1	0.01	0.922

Descriptive Statistics

Agile	Median	N <= Overall Median	N > Overall Median	Q3 – Q1	95% Median CI
0	94	18	17	82	(78.2190, 115.781)
1	87	9	9	71	(60, 121.964)
Overall	94				

95.0% CI for median(0) - median(1): (-34.6568,48.6568)



No difference in schedule risk

Schedule risk by Middle Tier Acquisition code

TYPE	P(≤60 Mo)	~Risk (> 60 Mo)
MTA	82%	18%
Not MTA	9%	91%

Test

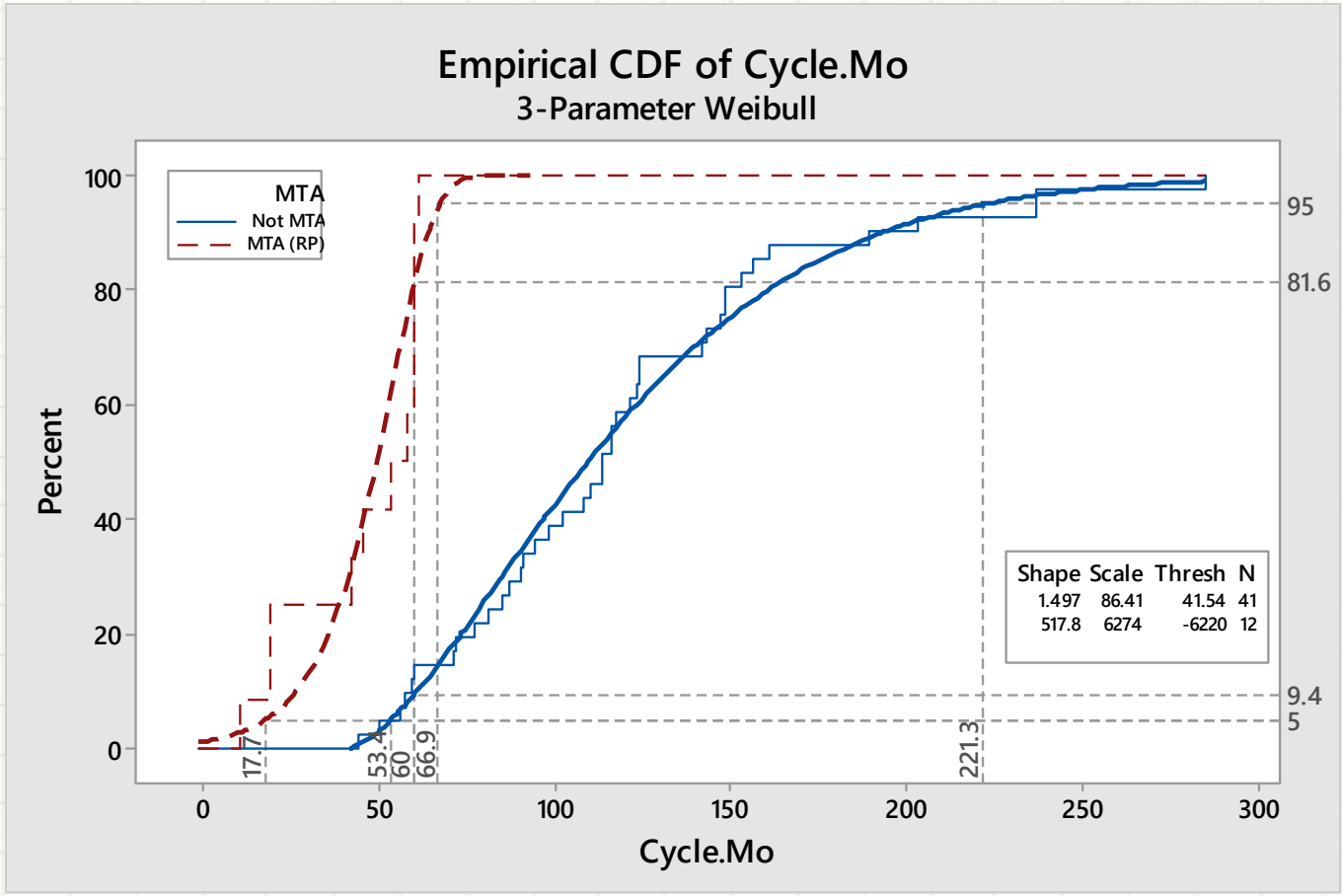
Null hypothesis	H_0: The population medians are all equal
Alternative hypothesis	H_1: The population medians are not all equal

DF	Chi-Square	P-Value
1	14.94	0.000

Descriptive Statistics

MTA	Median	N <= Overall Median	N > Overall Median	Q3 – Q1	95% Median CI
0	113.0	15	26	64.50	(93.4566, 124)
1	55.5	12	0	35.25	(25.0517, 60)
Overall	94.0				

95.0% CI for median(0) - median(1): (48,82.0544)



Statistical difference in schedule risk

Schedule risk by modularity code

TYPE	P(≤60 Mo)	~Risk (> 60 Mo)
Modular	17%	83%
Not Modular	32%	68%

Test

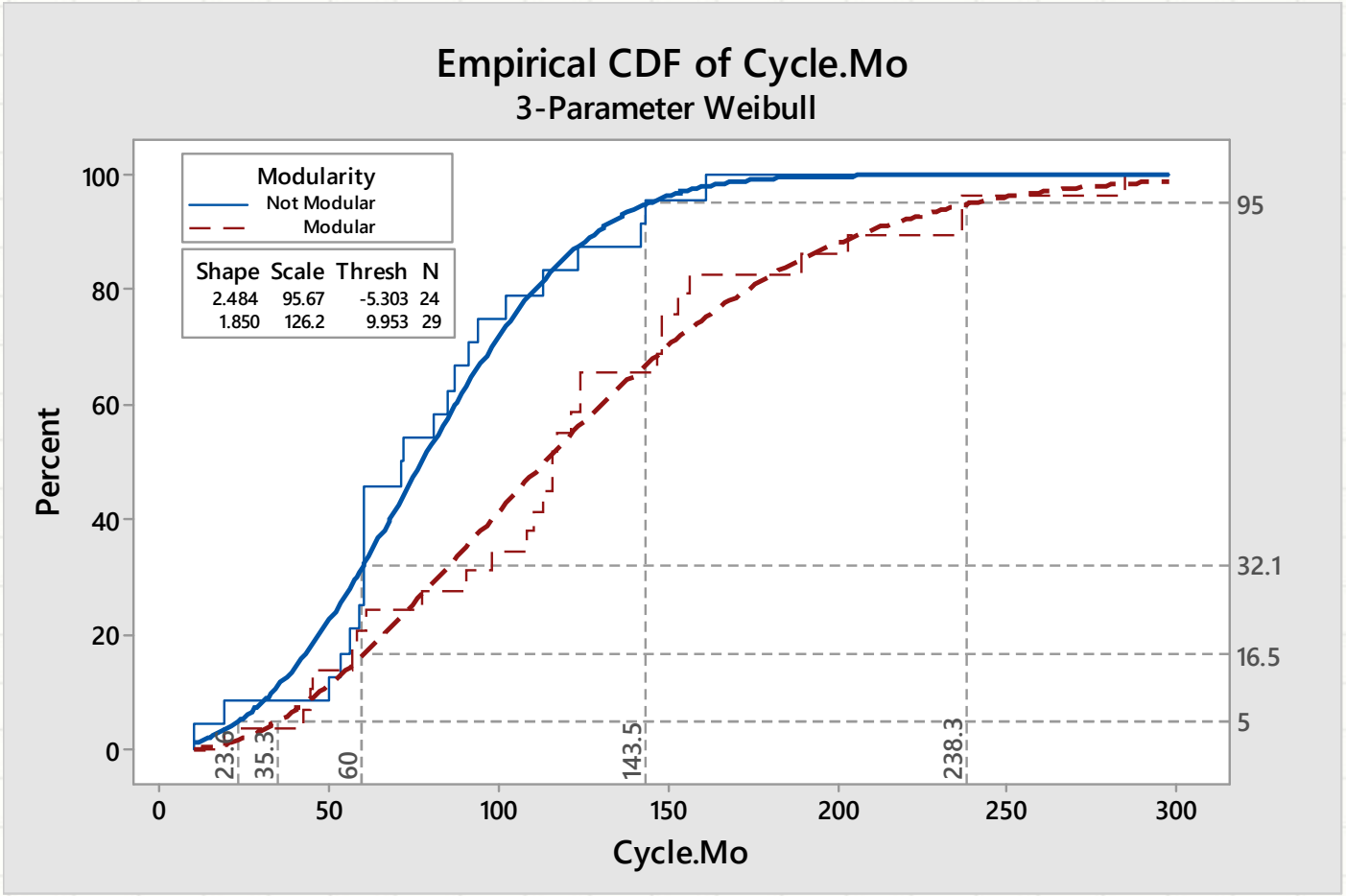
Null hypothesis H_0: The population medians are all equal
Alternative hypothesis H_1: The population medians are not all equal

DF	Chi-Square	P-Value
1	10.16	0.001

Descriptive Statistics

modular	Median	N <= Overall Median	N > Overall Median	Q3 – Q1	95% Median CI
0	71.5	18	6	40.75	(60, 91.5197)
1	116.0	9	20	81.50	(96.6738, 147.166)
Overall	94.0				

95.0% CI for median(0) - median(1): (-64,-20.8952)



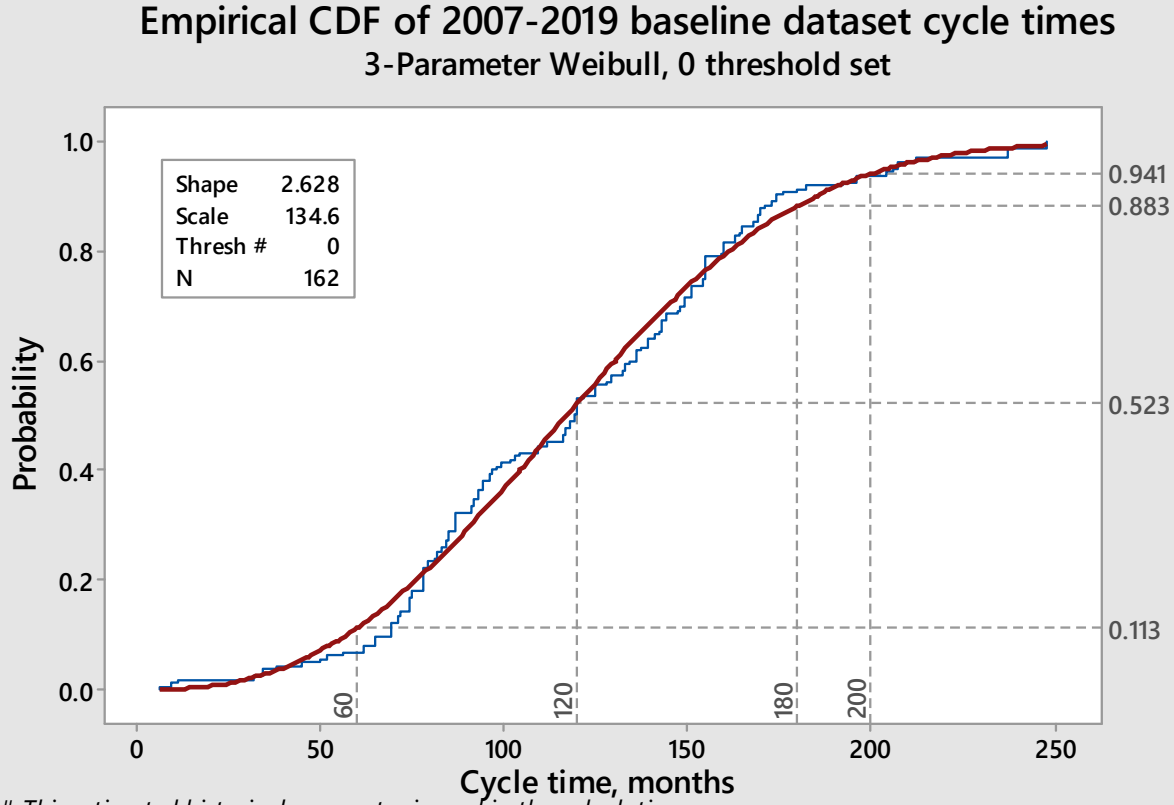
Statistical difference in schedule risk

Example model performance comparison

Test point	distribution	model	Error
60	11.3%	12%	<1%
120	52.3%	55.5%	<5%
180	88.3%	100%	<15%, <10%
200	94.1%	100%	<10%

Cycle time risk calculator

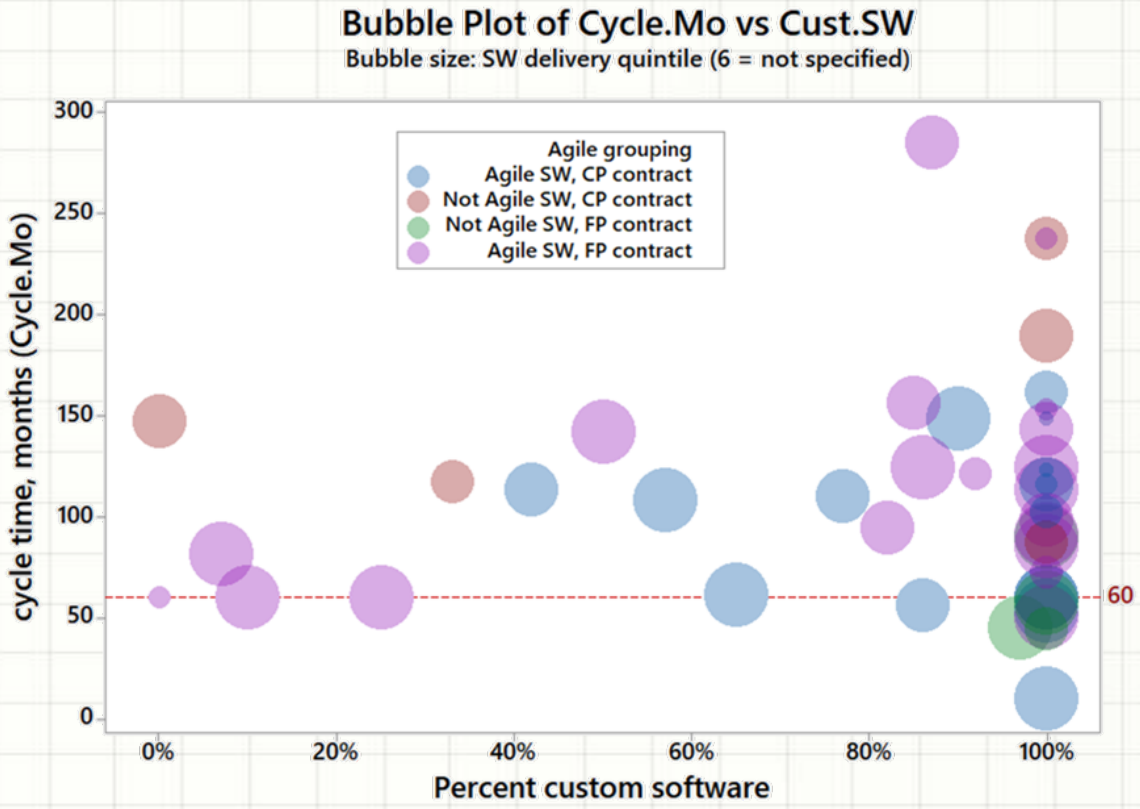
X = 200 months	Chance (≤ x)	Risk (>x)
Modular	90%	10%
Not Modular	0%	100%
Agile Acquisition	100%	0%
Not Agile Acquisition	79%	21%
Middle Tier model	100%	0%
Not Middle Tier model	73%	27%
Modification	100%	0%
GAO2020 dataset	73%	27%
2007-2019 baseline	100%	0%
average	93%	7%



 # This estimated historical parameter is used in the calculations.

Agile development

- Considering Agile Software and agile acquisitions processes
  - Programs mix processes
- Contract type matters
  - Fixed price – cost-constrained scope change
  - Cost type – negotiated scope change
- Qualitatively indifferent



Cycle time and schedule change regression models

Cycle.Mo = -10.2 + 18.98*LN.RD.M + SW.Gp + Joint + DEPEND + Reuse + COML + Fin_Uns

Where

- LN.RD.M is the natural log of the MDAP research and development budget in millions;
- SW.Gp = -27.38 for Agile, -24.2 for hybrid or N/A, 0 for waterfall approaches;
- Joint = -15.02 if MDAP is designated as Joint, else 0;
- DEPEND = 16.1 if MDAP depends on another MDAP, else 0;
- Reuse = -19.42 if in-service technology is re-used, else 0;
- COML = -23.99 if MDAP uses commercial technology to deliver capability; else 0; and
- Fin_Uns = 26.79 if more than 10% change in funding since program start, else 0

Cy.Mo.PCT = -0.0955 + 0.01979*P.M.PCT + 0.02706*CTES + Fin_Uns + ACQ_P + SVC + Restr + INTEG + NM

Where

- PM.PCT = percent change in procurement budgets since program start;
- CTES = number of Critical Technology Elements identified by GAO reporting
- Fin_Uns = 0.1230 if budgets change by more than 10 percent, else 0;
- ACQ_P = 0.3184 if model 2, - 0.023 if model 4, 0.0110 if model 5, or 0.0429 if model 6;
- SVC = 0.0 if AF, - 0.0765 if Army - 0.0218 if DoD, 0.1741 if Navy;
- Restr = 0.1301 if restructured, else 0;
- INTEG = - 0.1007 if there are system integration issues found during testing, else 0; and
- NM = 0.1258 if MDAP has a Nunn-McCurdy breach, else 0.

Research hypotheses supported

Significant cycle time (Cycle.Mo) predictors – new capability

GAO assessed *neither* technology or design as mature (00)

Cycle.Mo = 92.6 + 0.001097*RD.M + 17.46*UC.M.PCT + 5.12*LN.UC.M + COML

Where

- *RD.M* is the MDAP research and development budget in millions;
- *UC.M.PCT* is the GAO-reported percent change in unit cost since program start (100% change= 1.0, and can be negative);
- *LN.UC.M* = the transformed GAO-reported unit cost in millions; and
- *COML* = **-24.43** if MDAP uses commercial technology to deliver capability; else 0

GAO assessed *both* technology or design as mature (11)

Cycle.Mo = 91.08 + 0.003143*RD.M **- 58.2*** P_no.PCT + Joint + PM.oth

Where

- *RD.M* = MDAP research and development budget in millions;
- *P_no.PCT* = percent change in procurement quantities since program start
- 100% change= 1.0, (this value can be negative)
- *Joint* = **-86.3** if MDAP is designated as Joint, else 0;
- *PM.oth* = **26.74** if MDAP has outside program office direction on program execution, else 0.

Model	Ref ()	S	R-sq	R-sq(adj)	R-sq(pred)
Trained	(1)	30.81	65.29%	62.74%	57.91%
00	(3)	33.30	58.98%	56.05%	52.46%
11	(4)	31.32	66.10%	66.76%	58.94%

Significant factors for program cycle time and schedule change

Significant factors:

- R&D Budget, LN($ millions) (LN.RD.M)
- Procurement budget % Δ since start (P.M.PCT)
- Software approach (SW.Gp)
- DoDI 5000.02 acquisition model (ACQ_P)
- Joint program (Joint)
- Depends on other MDAPS (Depend)
- Reuses in-service DoD technology (Reuse)
- Uses Commercial technology (COML)
- Acquiring service (SVC)
- Number of Critical Technology Elements (CTES)
- System integration issues found during testing (INTEG)
- Financial instability - Δ budgets > 10% (Fin_Uns)
- Program restructured (Restr)
- MDAP has a Nunn-McCurdy breach (NM)

Cycle time (factor unit change = Δ months)	% cycle time change (factor unit change= % Δ)
R&D budget (+19)	Procurement budget % Δ (+.02)
Software approach: Waterfall (0), Agile (-27) Hybrid/NA (-24)	DoDI 5000.02 Acq model: Model 2 (+0.32), 4 (-0.02), 5 (+0.01), 6 (+0.04)
• Joint (-15) • Depends on other MDAPS (+16)	SVC AF (0), Army(-0.08), DoD (-0.02), Navy (+0.17)
• Reuses DoD tech (-19) • Commercial (-24)	Integration issues (-0.10) # CTES (+.03)
Financial instability (+27)	Financial instability (0.12) Restructured (+0.13) NM Breach (+0.13) (adds)
R-sq(pred)~ 58%	*R-sq(pred)~ 59%*