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WEDNESDAY SESSIONS
VOLUME I

Schedule Analytics

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Panel 4. Strengthening Schedule Estimates in MDAPs

Wednesday, May 4, 2016	
11:15 a.m. – 12:45 p.m.	**Chair: Rear Admiral Thomas J. Kearney, USN,** Director, Acquisition, Commonality, & Expeditionary Warfare, Naval Sea Systems Command ***Acquisition Cycle Time: Defining the Problem*** David Tate, Institute for Defense Analyses ***Schedule Analytics*** Jennifer Manring, Principal Economics and Business Analyst, The MITRE Corp. Thomas Fugate, Principal Acquisition and Program Management Analyst, The MITRE Corp. ***Toward Realistic Acquisition Schedule Estimates*** Raymond Franck, Professor Emeritus, U.S. Air Force Academy Gregory Hildebrandt, PhD Bernard Udis, Professor Emeritus of Economics, University of Colorado at Boulder

Schedule Analytics

Jennifer E. Manring—is a Principal Economics and Business Analyst at the MITRE Corporation. She has supported numerous DoD Sponsors, providing life cycle and independent cost estimates, cost benefit analysis, and data collection and analysis on a wide variety of DoD systems and platforms. Manring is trained and experienced on a number of commercial parametric software cost models and risk analysis tools. She has led several cost research initiatives in cloud computing, service-oriented architecture, and agile development and various independent schedule analysis assessments. Manring holds a BS in mathematics from the Virginia Polytechnic Institute and State University. [jmanring@mitre.org]

Thomas M. Fugate—is a Principal Acquisition and Program Management Analyst at the MITRE Corporation. He is the Acquisition Management Community of Practice leader and he supports DoD and federal acquisition efforts with a focus on rapid and agile practices to speed solutions with the lowest practical program risk. Formerly, he was an Army Special Operations Program Manager, responsible for delivering critically needed capability on substantially compressed schedules and fixed budgets. Fugate holds a BA from the California State University and an MS from the Naval Postgraduate School. He is DAWIA Level III certified in Program Management and Systems Engineering. [tfugate@mitre.org]

Introduction

Developing and effectively managing schedules is critical to the success of a program. Program managers are becoming increasingly aware of the need for greater accuracy in schedule estimation, assessment, and risk management to control cost and deliver on time. A Government Accountability Office (GAO) assessment of 86 programs that made up the 2012 portfolio of Major Defense Acquisition Programs (MDAPs) found that the portfolio experienced total acquisition cost growth of 38%. In addition, the average schedule delay in delivering initial capability was 27 months when measured against first full estimates (GAO, 2013), representing a 69% increase over a 12-year period.[1] Most Major Automated Information Systems (MAIS) programs experienced schedule delays ranging from six months to 10 years. Clearly, schedule can pose a significant risk and drive cost growth.

The purpose of this research was to help strengthen the acquisition community's ability to produce data-driven realism in program schedules. This research effort had three main focus areas: (1) compile schedule data from programs to identify key schedule drivers and characteristics and build a data repository, (2) analyze the data from statistical and qualitative perspectives, and (3) document data collected and analysis performed, and how it can be accessed for analysis.

The detailed approach used in the research was comprised of the following high-level steps:

- Identify and review primary data sources

[1] Calculated based on GAO data that the average schedule delay in delivering initial capabilities was 16 months in 2000 and, compared to 21 months in 2007, represents a 31% increase in schedule delays over a seven-year period. See the 2008 GAO report on 95 weapons systems cited by Meier (2010).

- Develop a list of program attributes to evaluate
- Develop an Excel-based data collection framework
- Collect data and populate data repository
- Synthesize and cleanse data
- Analyze and assess data
- Develop findings
- Document research

The initial focus of the data collection phase was to identify, understand, and review existing external data repositories or sources that collect enterprise-level acquisition information and data, particularly related to program schedule. Across the federal government, the Department of Defense (DoD) sources and the Office of Management and Budget (OMB) Information Technology (IT) Dashboard were data sources identified and reviewed for this research.

Based on the data source review, the study team determined that the Defense Acquisition Management Information Retrieval (DAMIR) was the best source of data for DoD large scale programs as it contained both MDAP and MAIS program data (DoD, 2015). Although the DAMIR data is high level, it provided sufficient schedule fidelity and additional cost and program parameters of interest to be useful for the research. However, detailed reviews of the OMB IT Dashboard data revealed that schedule data is highly aggregated. Program start date and program end date are the only schedule parameters included with no intermediate schedule milestone data available in the repository. The OMB IT Dashboard has a large amount of data; however, without further fidelity and definition for schedule data, it was determined that it would not be useful to this research. No additional enterprise-wide acquisition data sources with relevant schedule data were identified; however, there are likely other centralized systems that contain acquisition information but are not open source.

Ground rules and assumptions (GR&As) were developed to bound and scope the research and establish baseline conditions for the analysis. Key GR&As included the following:

1. Only actual data was analyzed. Future schedule dates were excluded from the analysis.
2. Milestone equivalents were assumed to compare data between older program milestones and new program milestones, e.g., MS II = MS B.

Programs with negative or zero schedule durations between milestones were removed from the analysis as these reflect acquisition process anomalies. Negative duration values could occur either when the program had unique circumstances that caused milestones to take place in non-sequential order or could represent an error in the data.

The study team developed an Excel-based data framework that included schedule parameters, cost parameters, and program attribute parameters that were both available and of interest to analyze. Cost by appropriation, major schedule milestone dates, and life cycle phase were collected. Program attributes collected included program type, assigned component, acquisition category, Joint Capability Area (JCA), new start or modification, and whether a breach occurred within the program. Additionally, program baseline costs were synchronized into constant year 15 millions of dollars (CY15$M) to avoid any dollar distortions in the data. Schedule durations between milestones were calculated (in months) and included in the repository. The analysis focused on analyzing predictors of schedule duration.

In total, the study team analyzed more than 2,600 data points, including 560 schedule milestone dates from 143 MDAP and MAIS programs from DAMIR. Table 1 shows a summary of the data points collected. Within the schedule data points, the largest data for MDAP and MAIS programs were for MS B and MS C. The data had all Services represented, with Navy and Air Force having slightly more data points. Lastly, the data showed each of the JCA areas represented, with Force Application having slightly more data points. Although the data was high level, it provided sufficient schedule fidelity and additional cost and program parameters of interest to have value for the research.

Table 1. Data Collection Summary

	MDAP	MAIS	Total
Programs	80	63	143
Data Points	1,400	1,250	2,650
Schedule Data Points	287	274	561

The data analysis began with synthesizing and cleansing the collected data. The next phase was characterizing the data. The size and makeup of the data by the different parameters collected was analyzed for insights, trends, and relationships. The analytic tool was Excel with data analysis add-in features as well as graphing capability. Scatter plots, trend lines, and various statistical analysis were conducted to gain insight into what relationships the data may reveal. Additional ways of analyzing the data, such as changes over time, were also performed for further insight.

Among the key findings was a wide range of variability and a lack of strong linear relationships between schedule durations and program attributes analyzed. This implies that the complexity of DoD large-scale programs was not easily explained by predictive parameters such as cost, program type, JCA, and Service, for example. Despite this, the research revealed several emergent trends. Presented in this summary are two emergent trends:

Trend 1: Average MS B to MS C durations, which accounts for the Engineering and Manufacturing Development (EMD) Phase of the DoD acquisition life cycle, have decreased 43% for MAIS and 42% for MDAPs over the last 25 years, as shown in Figures 1 and 2. This reduction in the EMD phase average duration was not easily explained by the data, but suggests that various efforts to improve acquisition outcomes may have contributed to reduced development schedules. For example, in the last 25 years, large acquisition programs have trended away from single pass (aka, “Big Bang”) efforts in favor of incremental development and delivery of needed capabilities.

Figure 1. MDAP Development Times

Figure 2. MAIS Development Times

Trend 2: From a cost correlation perspective, the study team observed that higher Research, Development, Test, and Evaluation (RDT&E) costs as a percentage of total Acquisition Costs correlated with shorter EMD schedule durations for both MAIS and MDAP efforts. This observation suggests that development schedules may be "bought down" with a greater share of the total acquisition budget, as depicted in Figures 3 and 4.

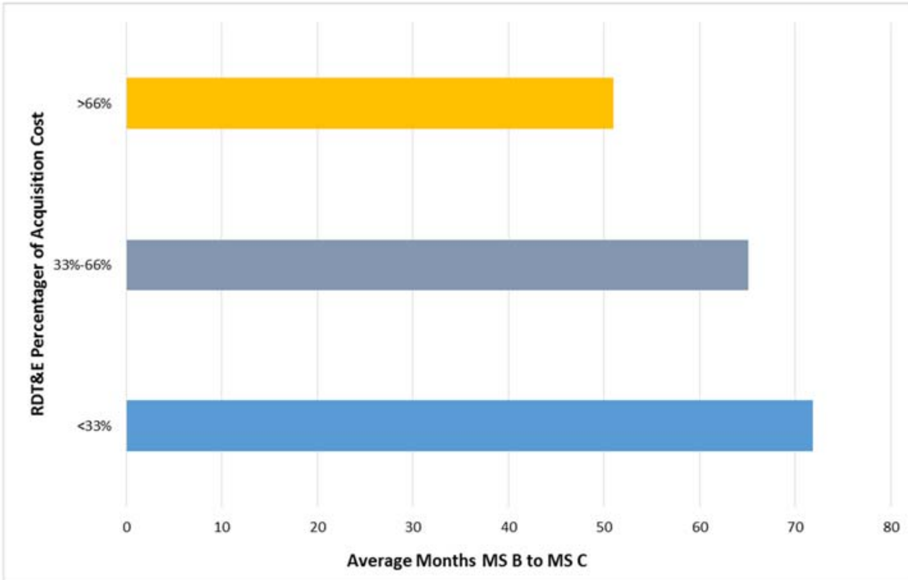

Figure 3. MDAP RDT&E Percentage vs. Schedule (MS B to MS C)

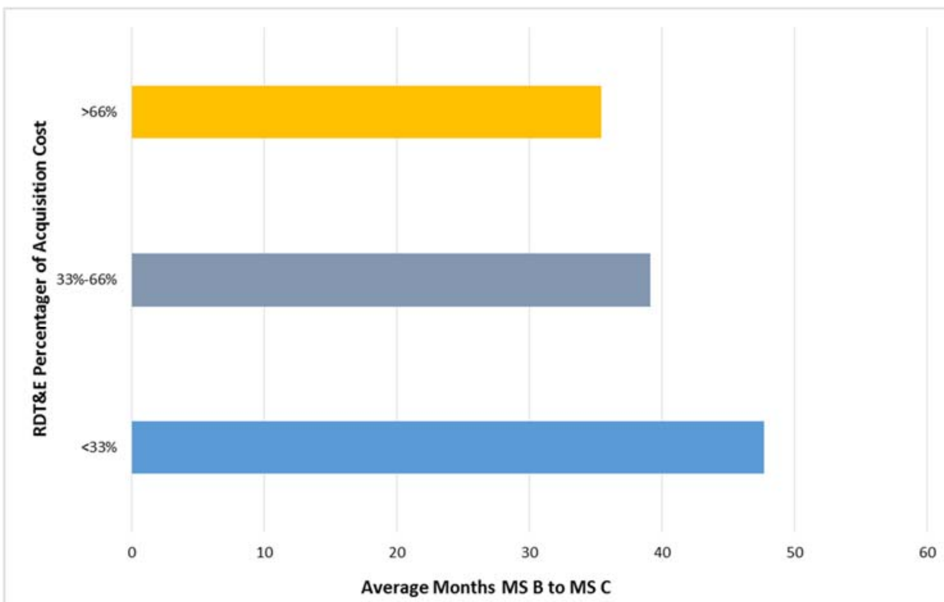

Figure 4. MAIS RDT&E Percentage vs. Schedule (MS B to MS C)

The data collected during this research can be used to help validate schedule realism and identify schedule outliers compared to major DoD programs with similar program attributes. For more comprehensive analysis and higher confidence predictive measures, additional parameter analysis such as requirements and funding stability, program office maturity, governance structures, and technology maturity is needed. Also, as noted, the dataset covered only large DoD programs. The study team did not find useful data for civil-sector and below ACAT-I threshold DoD programs.

In summary, the data suggested some emergent trends; however, the data had a lot of variability and a wide range for most schedule milestones. The data also does not appear to have strong linear relationships between schedule milestone length and program attributes analyzed for either MAIS or MDAPs. One explanation is that the complexity of large-scale DoD programs is not easily explained in full by the selected predictive parameters. Additional parameter analysis is needed to explain and predict schedule differences (such as funding stability, program manager experience, requirements change, technology readiness levels, etc.), but these parameters may be difficult to collect. However, the data collected is a rich dataset that can be used for analogy comparisons for large DoD programs. The study team recommends the data be used to perform high-level schedule assessments or for analogies to evaluate schedule realism throughout a program's life cycle.

References

DoD. (2015, January). *Description and Decision Authority for ACAT I–III Programs* [Table 1] (DoDI 5000.02). Washington, DC: Author.

GAO. (2013, March). *Defense acquisitions: Assessments of selected weapon programs* (GAO-13-294SP). Washington, DC: Author.

Meier, S. R. (2010, March). Casual interferences on the cost overruns and schedule delays of large-scale U.S. federal defense and intelligence acquisition programs. *Project Management Journal.*

Acknowledgments

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Major DoD Acquisition Program Schedule Analytics

Tom Fugate

Jennifer Manring

May 2016

Context

Program schedules are often driven by

- Operational commanders expectations
- Acquisition Executive's direction
- Budget availability and type
- PMO guestimates
- Politics

Instead of data driven analytics **of related programs**

Leading to

- Delays against unrealistic schedule baselines
- Cost overruns
- Poor analysis, planning, and execution
- Considerable program risk
- Unhappy sponsors/users

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Goals of This Research

- **Provide Acquisition Executives**
  - Data to validate schedule realism
  - Identify schedule trends
  - Identify schedule correlations to program elements
  - Identify any correlations to major policies, initiatives, and laws
- **Provide Program Offices**
  - Data to help shape realistic schedules
  - Identify where their schedule is an outlier to related programs
- **Identify additional schedule analysis opportunities and applications**

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Research Questions

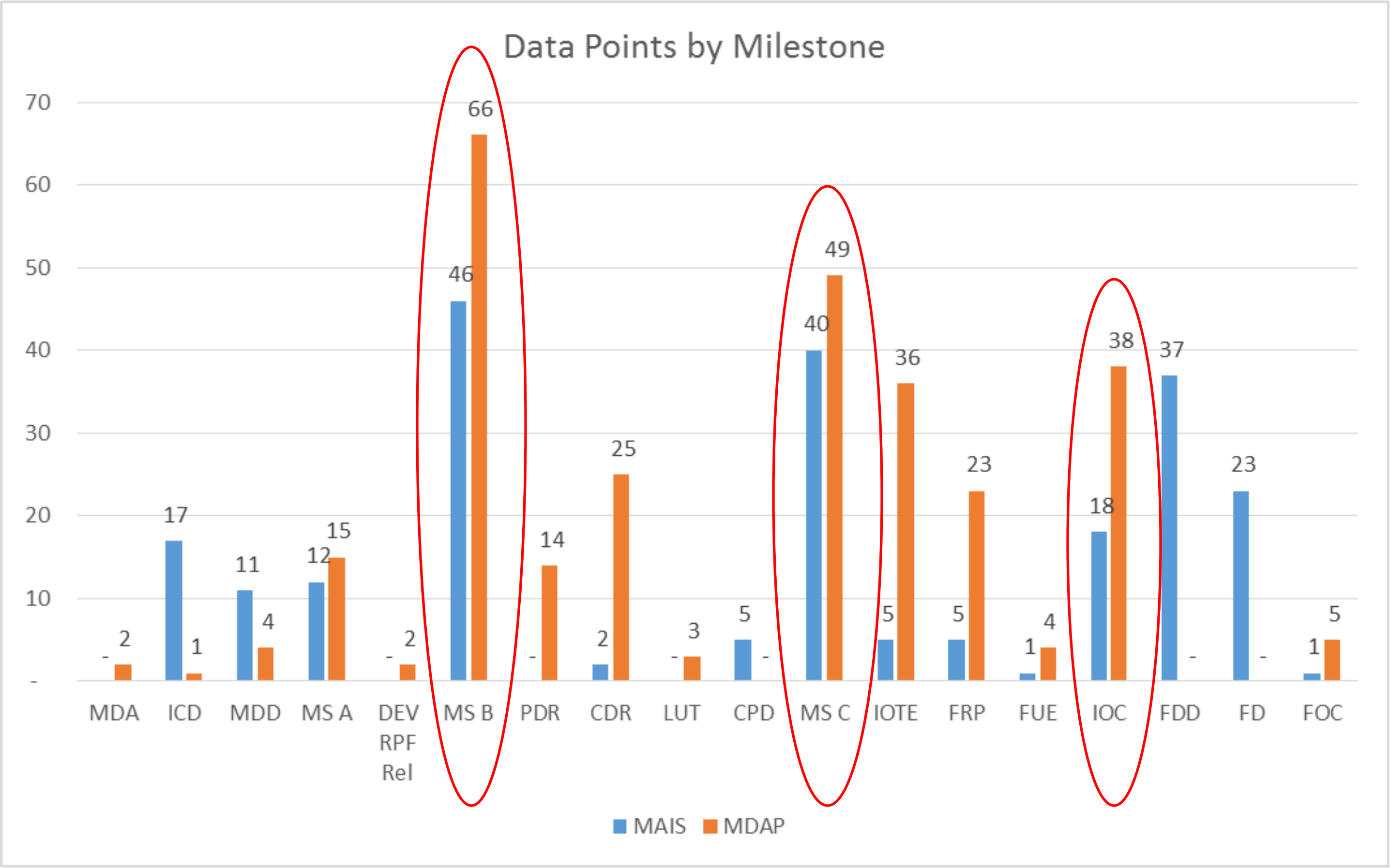
- **What are the average timelines for MDAP and MAIS programs?**
- **What are the schedule trends for these programs?**
- **How do schedules vary by:**
  - Cost
  - ACAT
  - Service
  - Joint Capability Area
  - % RDT&E $ vs Procurement
- **Are there correlations to key program attributes?**
- **How does the schedule data analysis align with major policies, initiatives, and acquisition reform legislation?**

Schedule Data Summary

	MDAP	MAIS
Programs	80	63
Army	*16 (20%)*	*16 (25%)*
Navy	*35 (44%)*	*13 (21%)*
Air Force	*26 (32%)*	*15 (24%)*
DoD	*3 (4%)*	*19 (30%)*
Data Points	1,400	1,250
Schedule Data Points	287	274
Avg. Lifecycle Cost (CY15)	$37B	$2.3B

- **Collected data from DAMIR for all MDAPs and MAIS Programs**
- **Synthesized, synchronized, and cleansed data**
- **Analyzed and assessed data holistically and by segments**

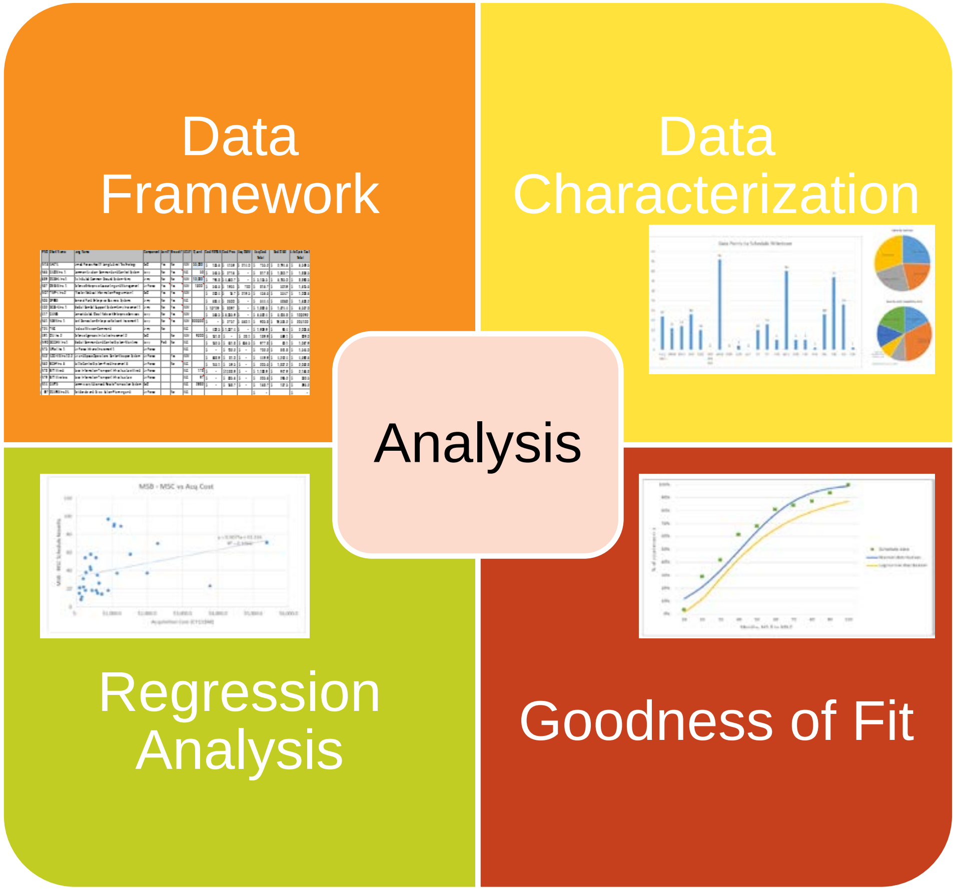
Data Characterization



Largest data sets for MS B, MS C, and IOC milestones

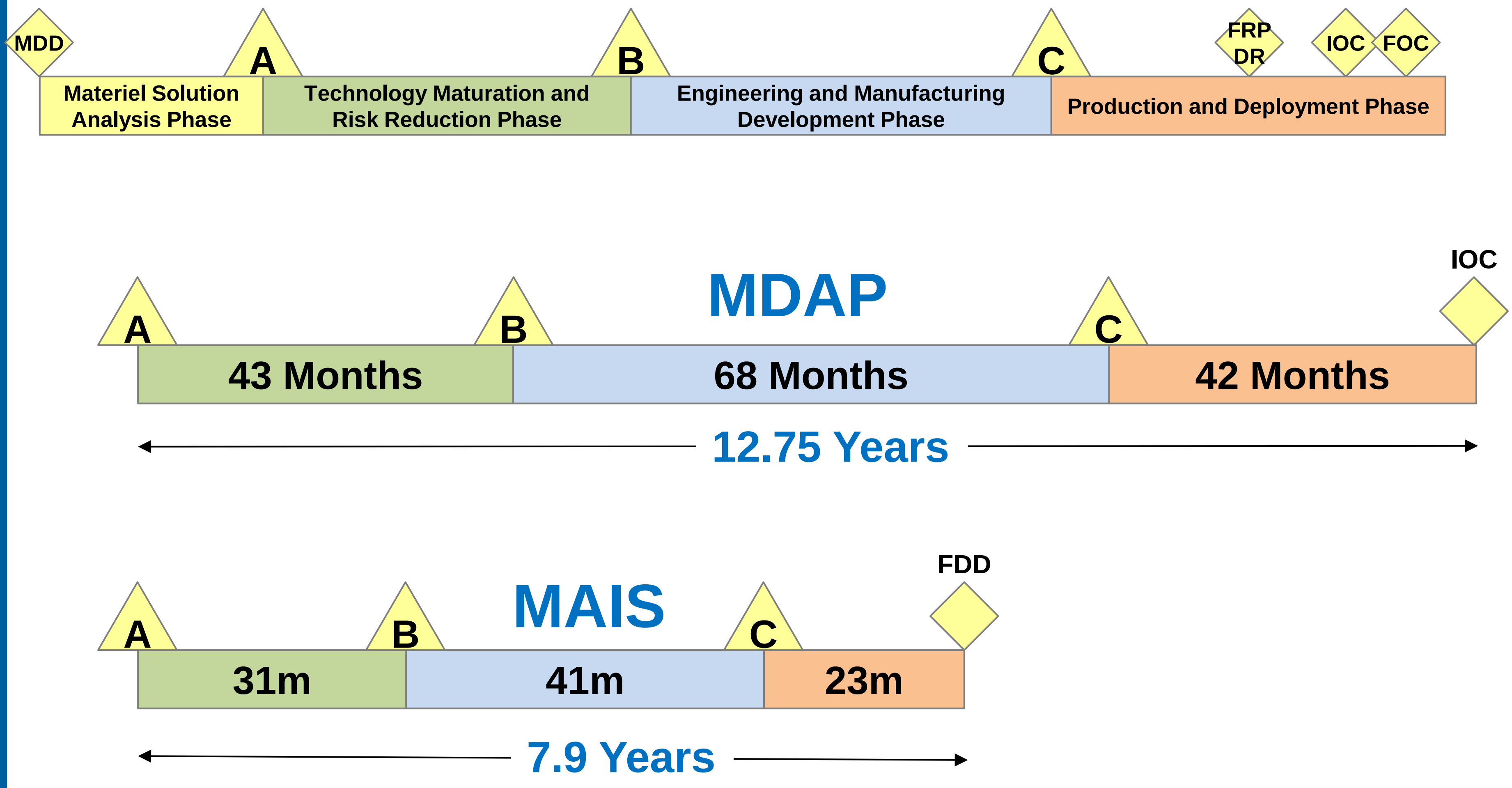
Methodology

- **Methodology**
  - Identified and reviewed primary data sources
  - Developed list of program attributes to evaluate
  - Created data framework
  - Collected data
  - Synthesized and synchronized data
  - Analyzed and assessed data
  - Captured findings
  - Documented research



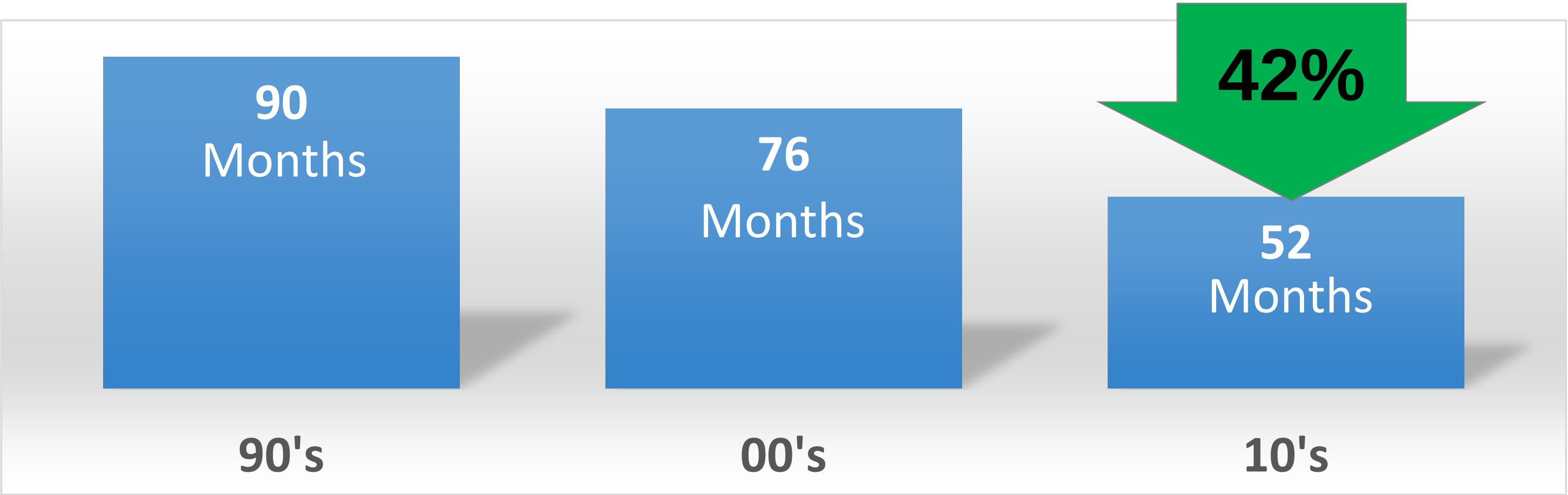
Average MDAP and MAIS Timeframes

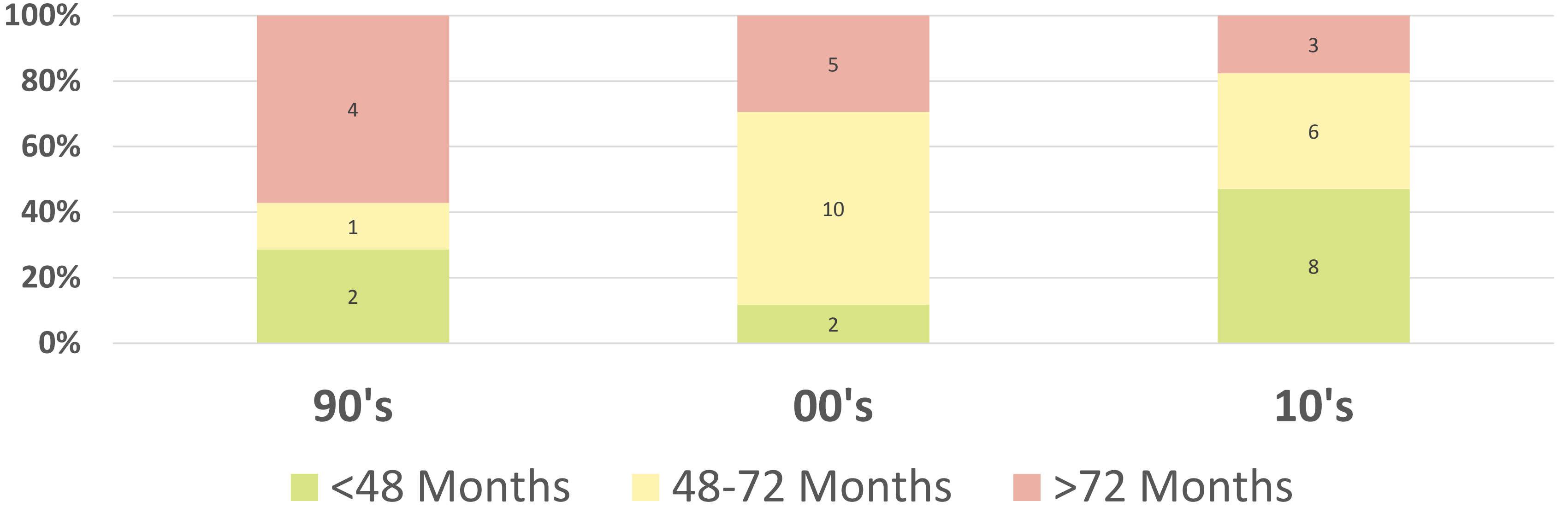
80 MDAPs, 63 MAIS - 1990's to Today



MDAP Development Timelines

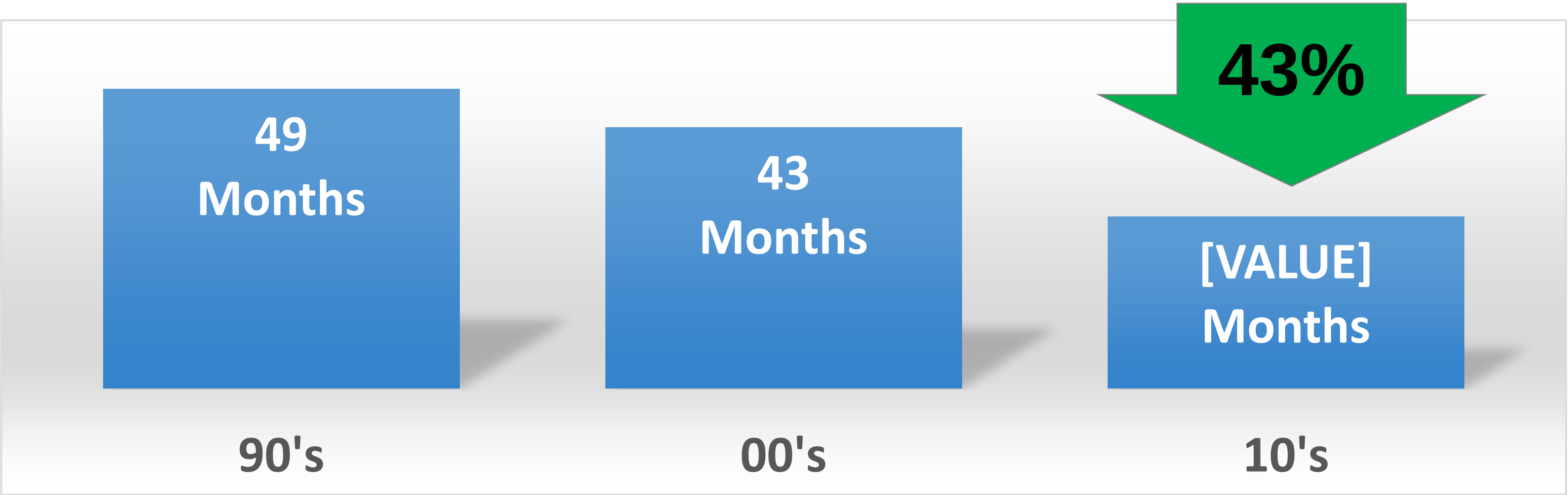
MS B ⟶ MS C

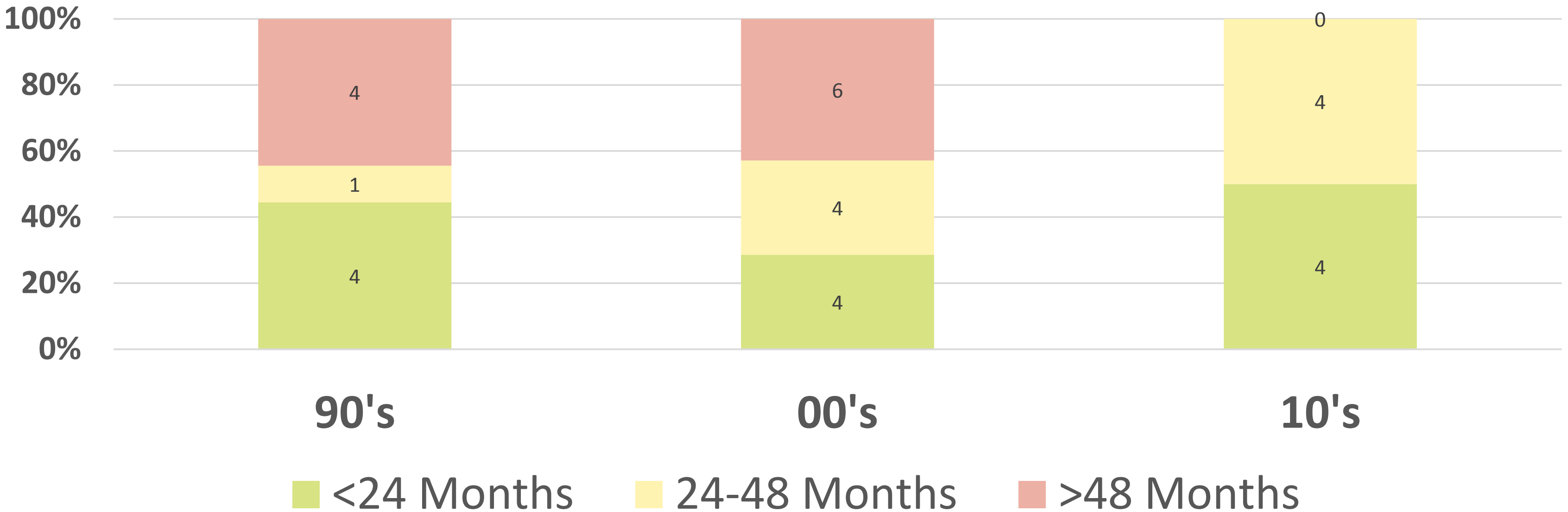




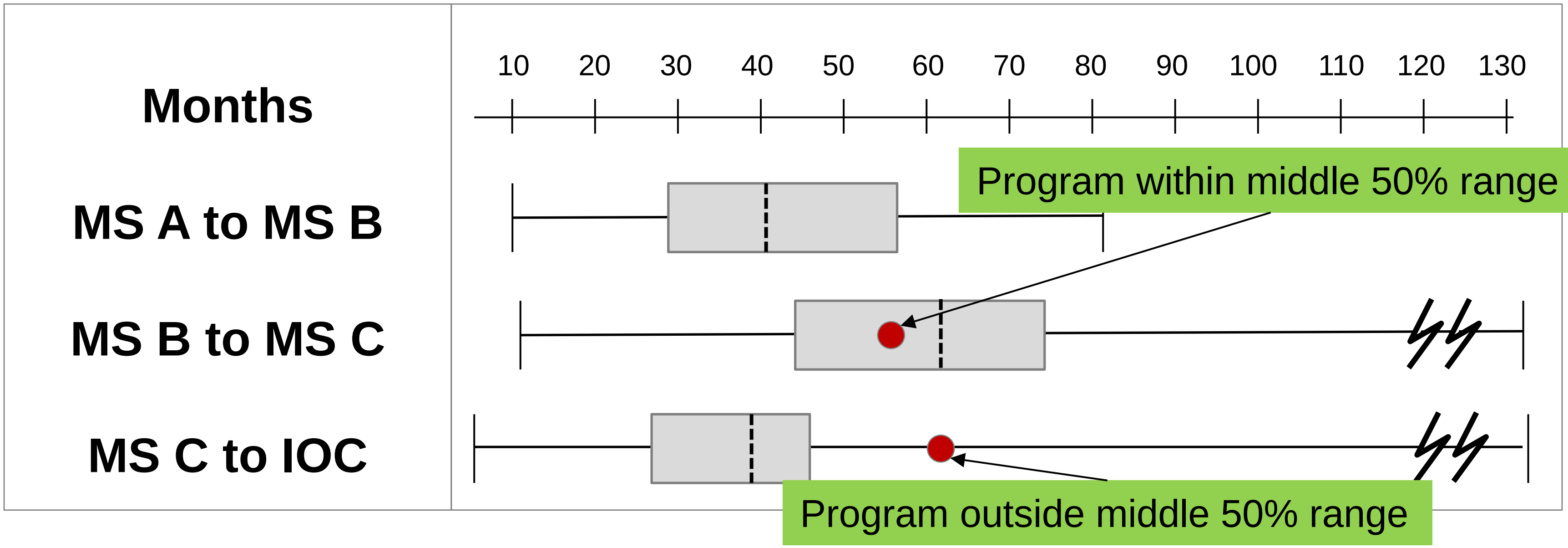
MAIS Development Timelines

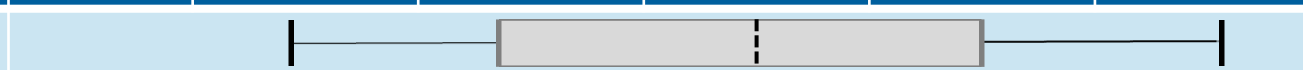
MS B ⟶ MS C





MDAP Schedules – Acquisition Milestones



	n	Min	25%	Median	75%	Max
						
MS A to MS B	15	10m	28m	41	57m	81m
MS B to MS C	41	11m	43m	62	76m	234m
MS C to IOC	30	2m	27m	38	46m	146m

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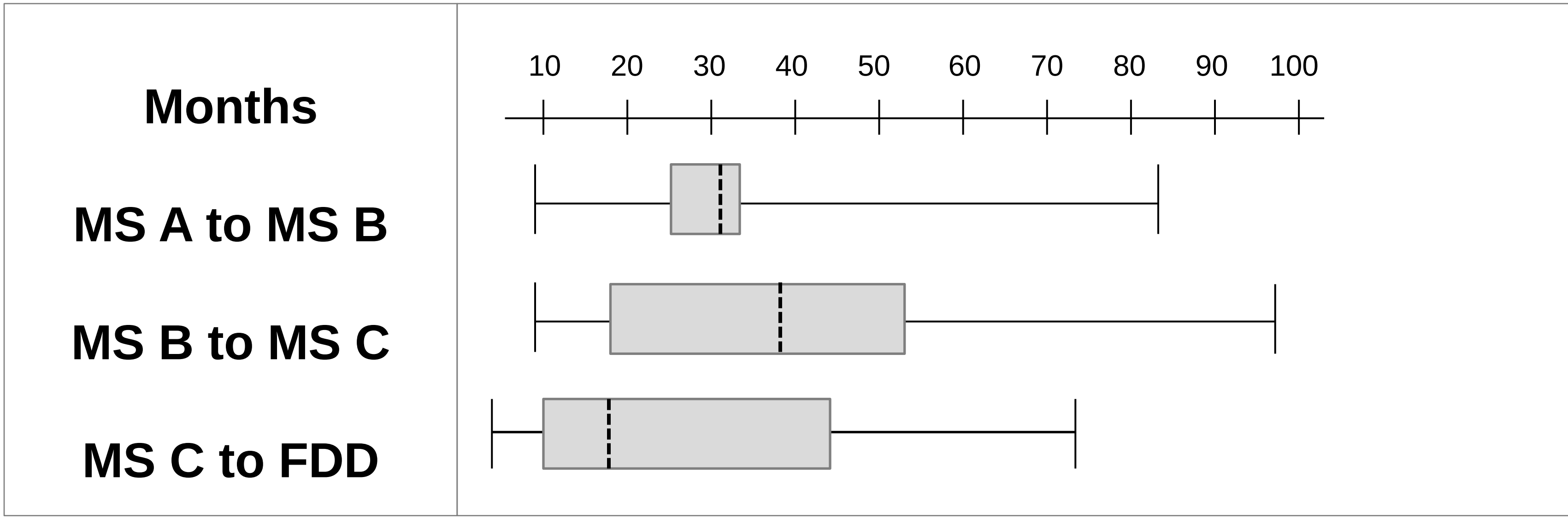
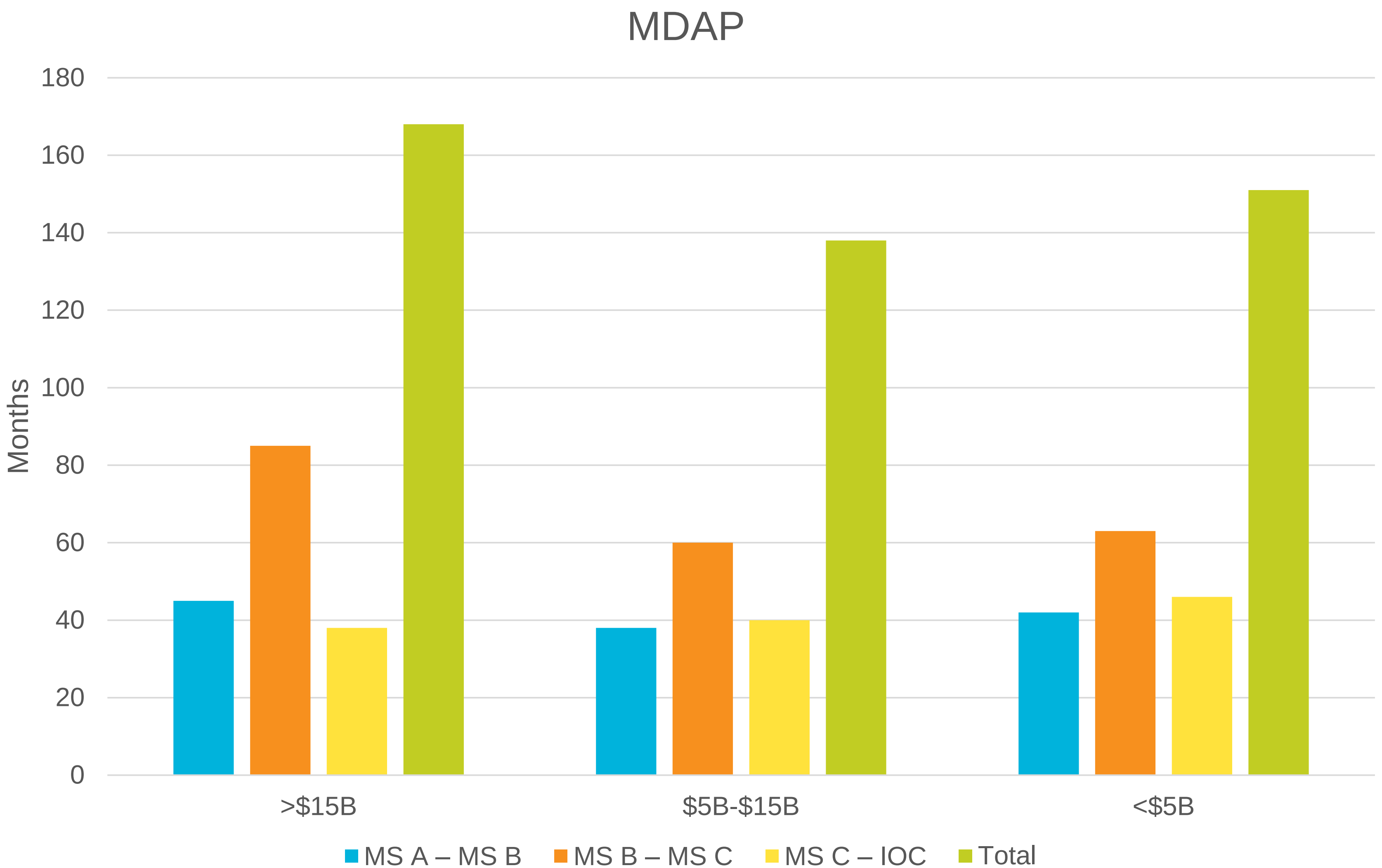
MAIS Schedules – Acquisition Milestones

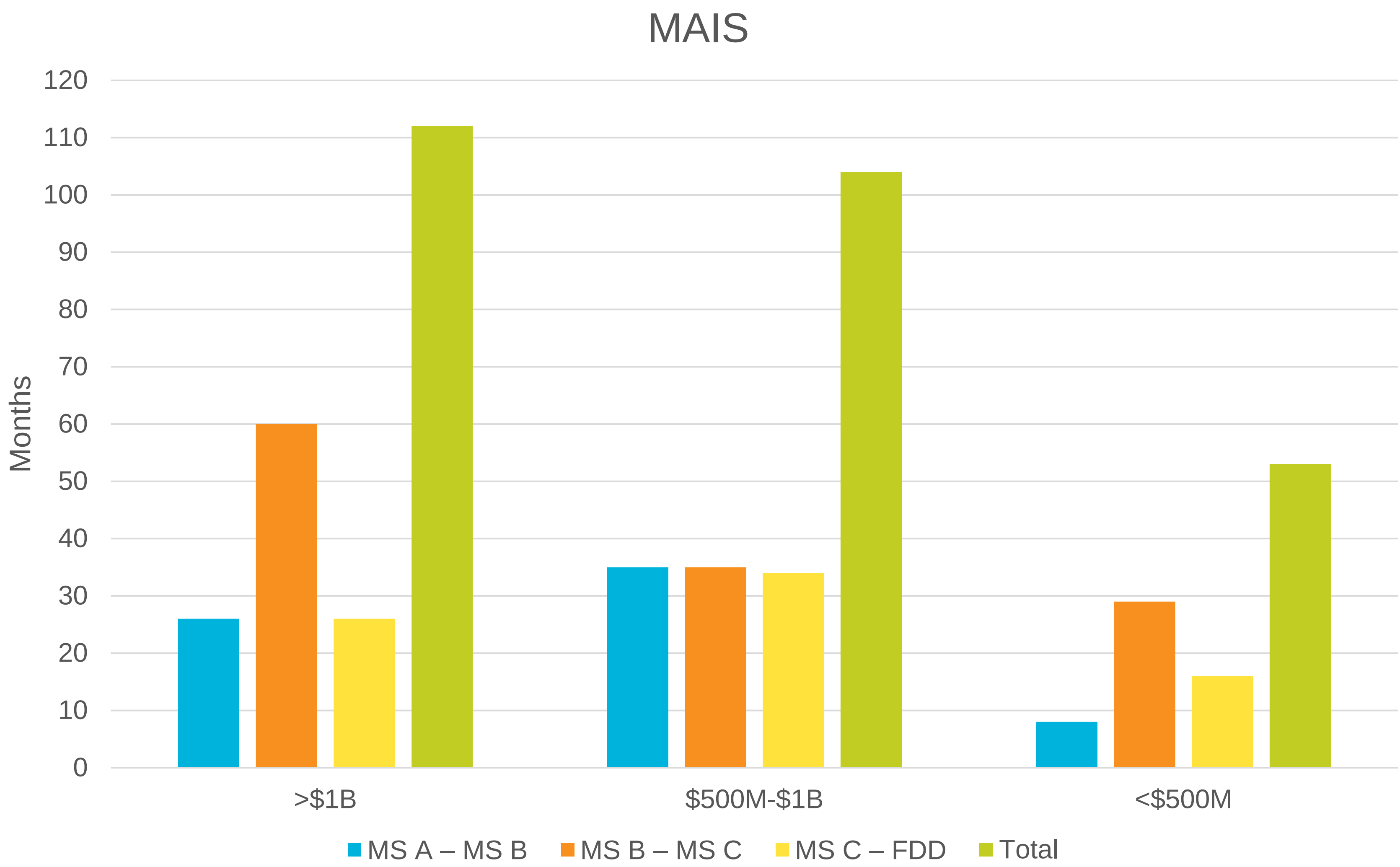


	n	Min	25%	Median	75%	Max
MS A to MS B	9	8m	24m	32m	33m	82m
MS B to MS C	31	8m	18m	37m	54m	97m
MS C to FDD	26	2m	9m	16m	41m	72m

MDAP Acquisition Cost vs. Schedule



MAIS Acquisition Cost vs. Schedule



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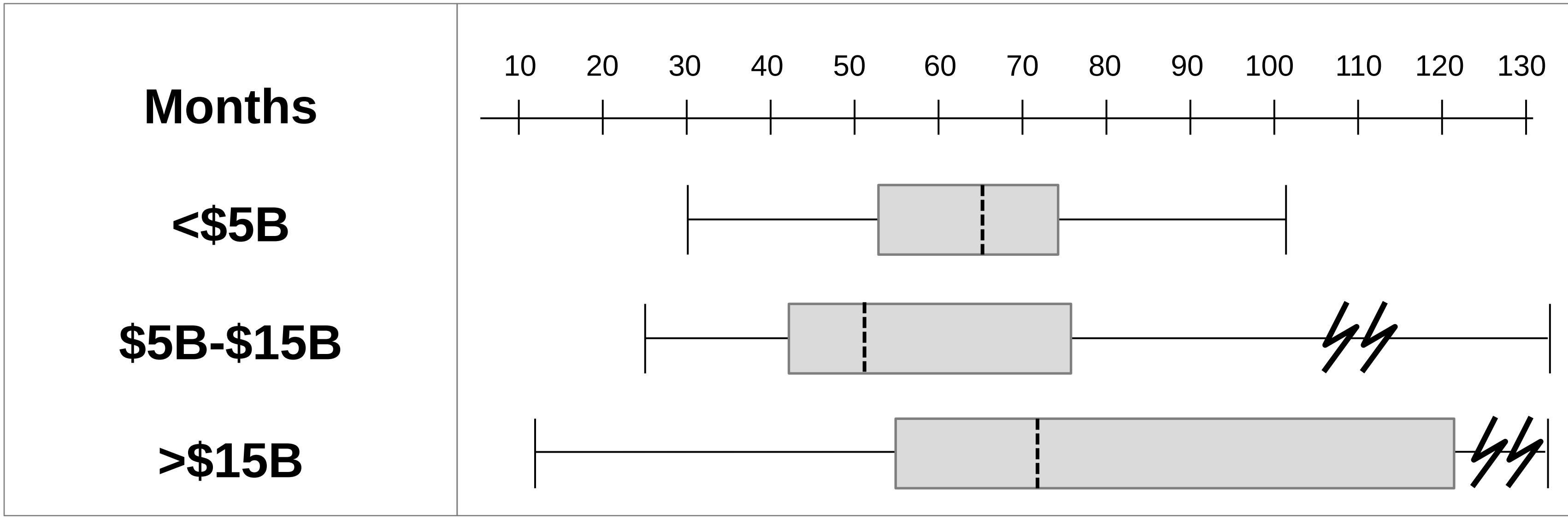
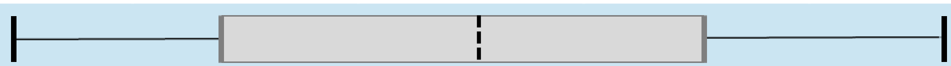
MDAP Acquisition Cost vs. Schedule

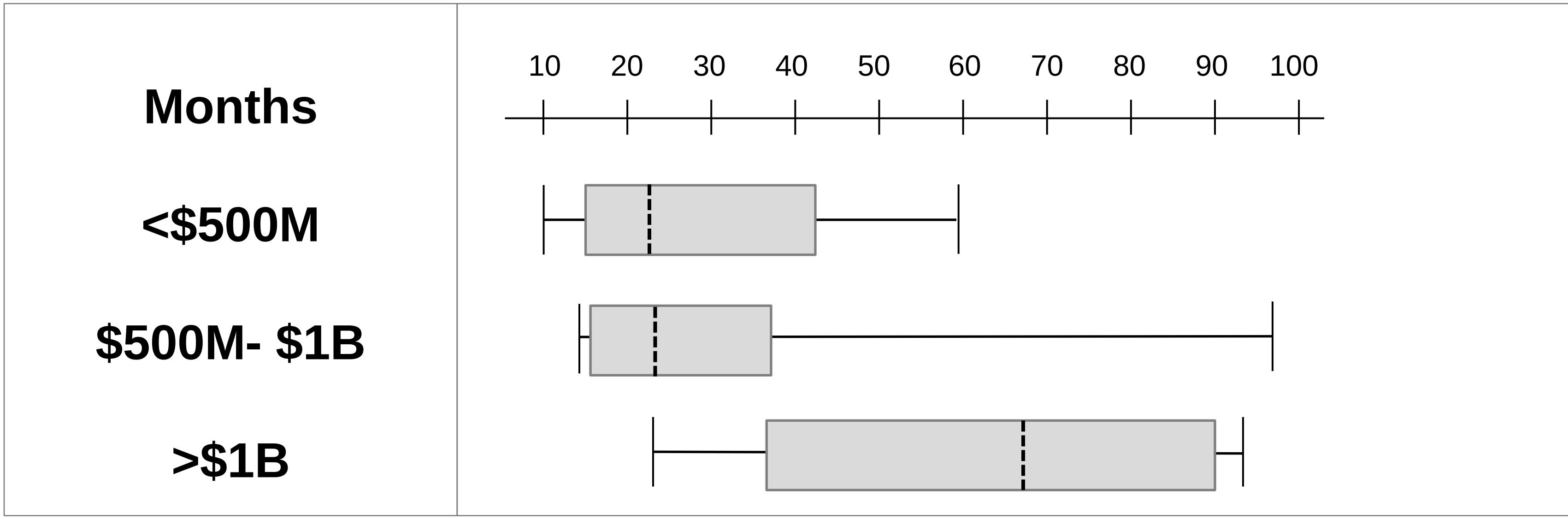
MS B to MS C



	n	Min	25%	Median	75%	Max
						
<$5B	14	30	52	65	74	103
$5B-$15B	15	25	41	50	75	140
>$15B	11	11	53	71	122	234

MAIS Acquisition Cost vs. Schedule

MS B to MS C



	n	Min	25%	Median	75%	Max
<$500M	13	8m	15m	22m	41m	58m
$500M-$1B	8	14m	15m	22m	35m	97m
>$1B	10	23m	37m	64m	89m	91m

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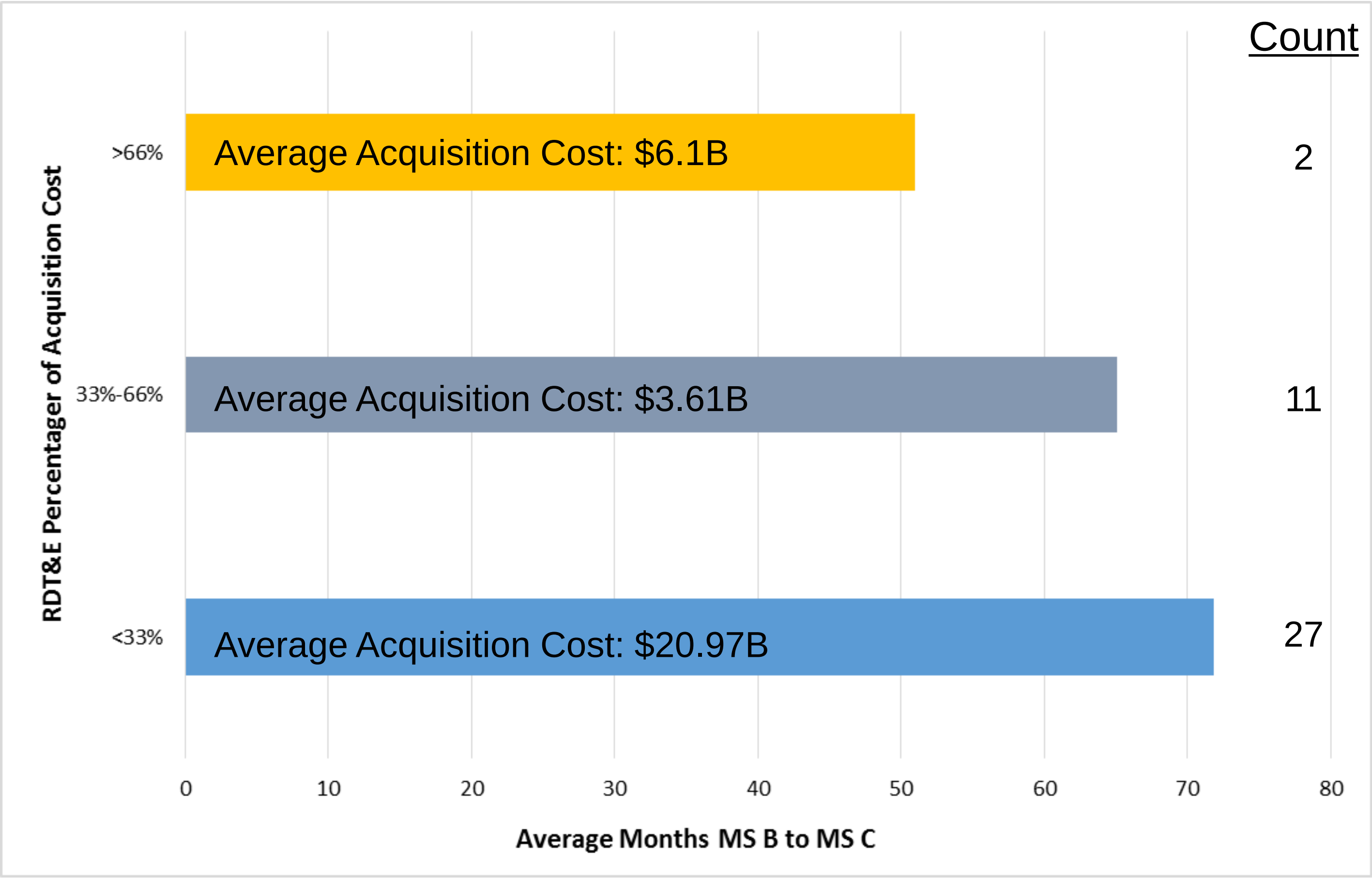
MDAP RDT&E Percentage vs. Schedule
MS B to MS C



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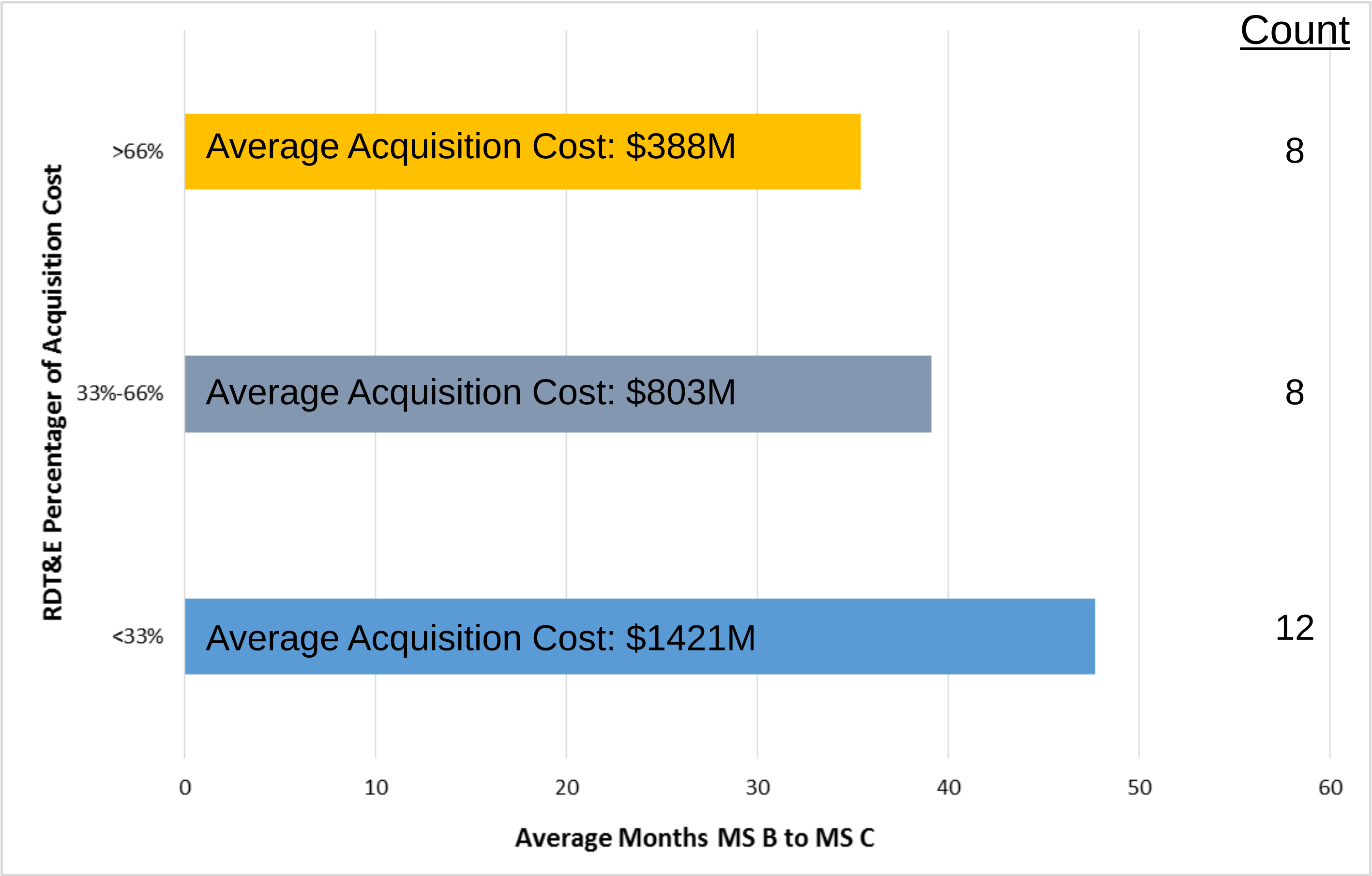
MAIS RDT&E Percentage vs. Schedule

MS B to MS C



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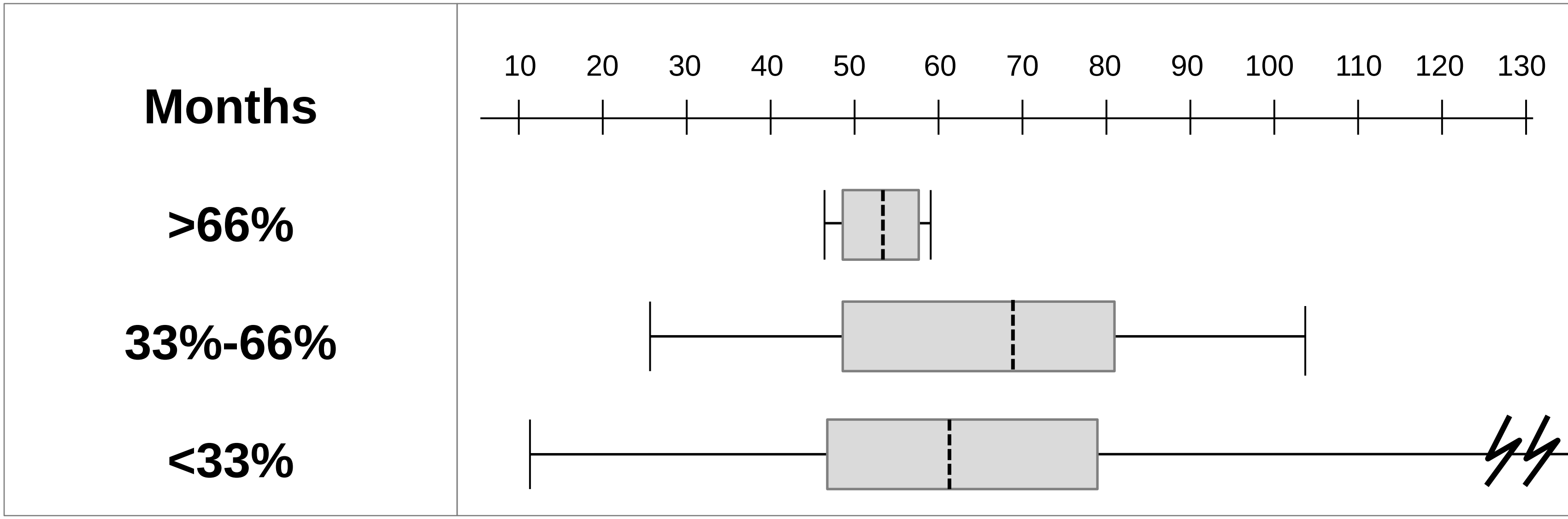
MDAP RDT&E Percentage vs. Schedule

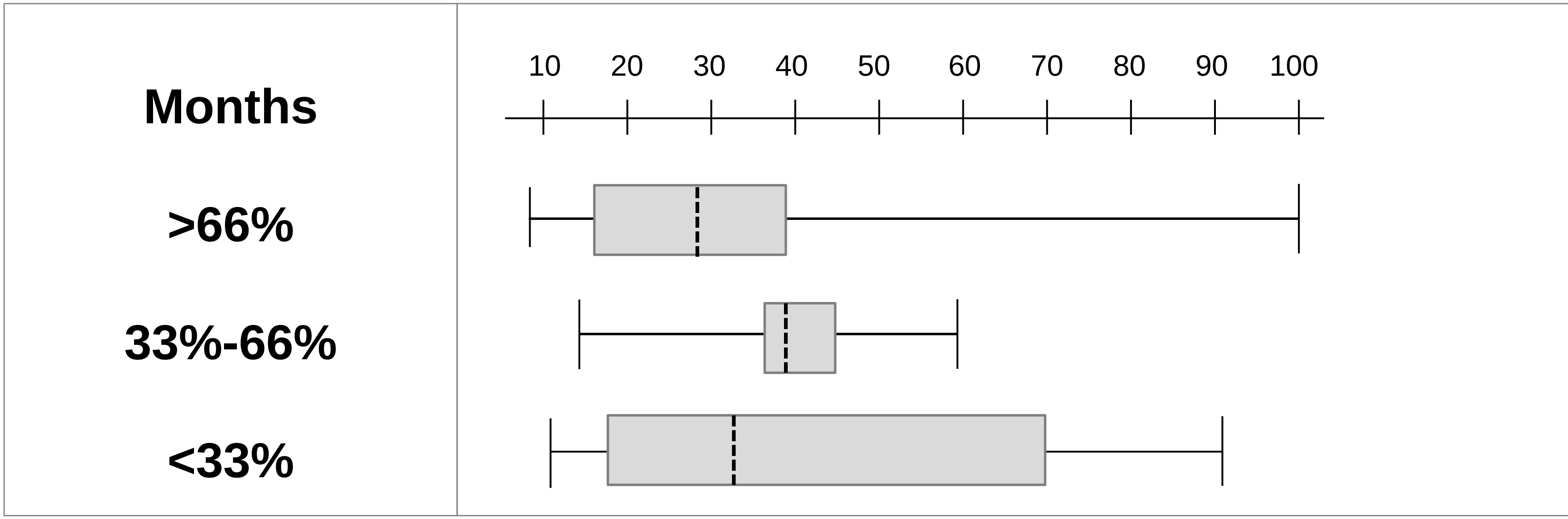
MS B to MS C



	n	Min	25%	Median	75%	Max
>66%	2	45	48	51	54	57
33% - 66%	11	25	48	67	80	103
<33%	27	11	46	61	78	234

MAIS RDT&E Percentage vs. Schedule

MS B to MS C



	n	Min	25%	Median	75%	Max
>66%	8	8m	15m	27m	38m	97m
33%-66%	8	14m	35m	37m	41m	58m
<33%	12	11m	18m	32m	70m	91m

Conclusions

- **Data suggests some emergent trends**
  - MS B and MS C Durations decreasing over time
  - Greater RDT&E as a percentage of acquisition cost appears to drive shorter development schedules
- **Data can be leveraged to inform schedule realism**
- **Data has variability and a wide range for schedule milestones**
- **Complexity of DoD large scale programs not easily explained by predictive parameters such as cost, type, service**

- **Recommend data be augmented if additional data sources are uncovered and/or program data (actuals) – especially civilian and small/med DoD programs**
- **Invitation to participate and contribute data sources**

Thank You

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