Telling Time:

Getting Relevant Data for Acquisition Schedule Estimating Relationships

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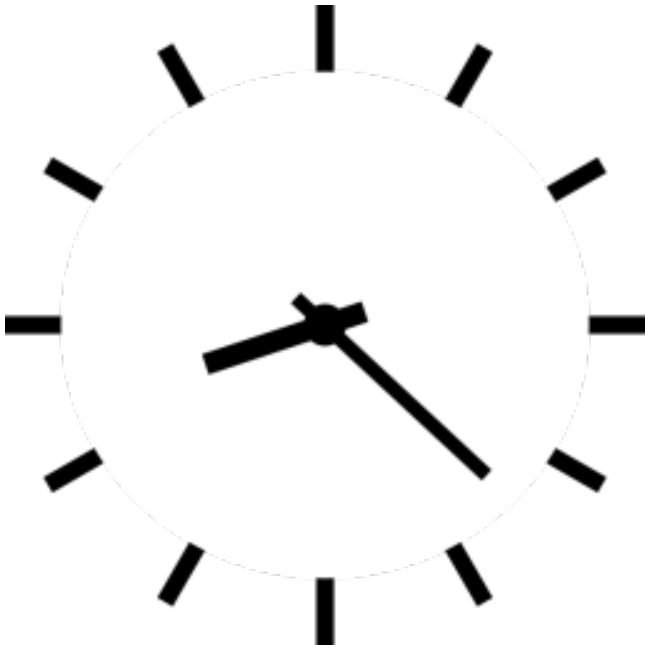
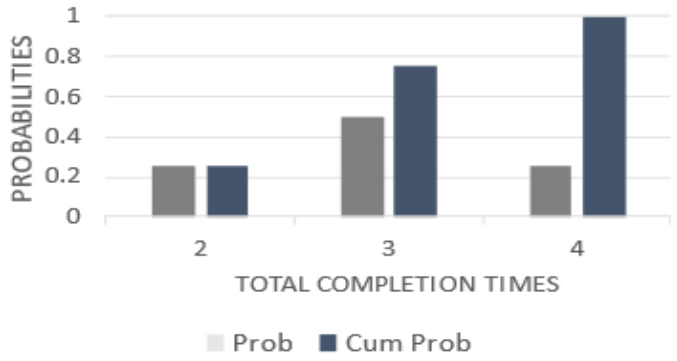


Some Near-Universal Schedule Estimating Complications

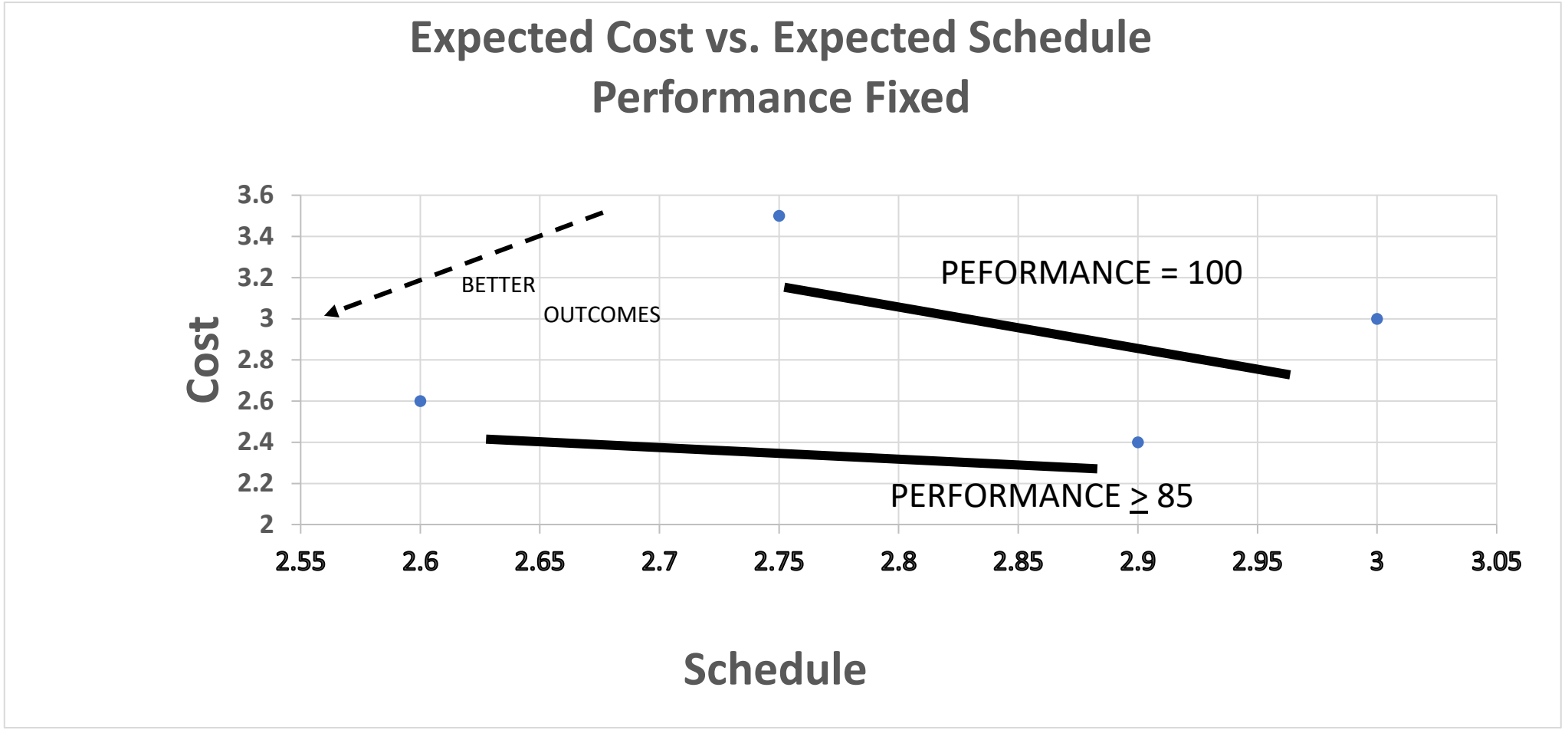
- External Factors
  - acquisition policy regime (McNicol and Wu, 2014),
  - funding "climate" (McNicol 2015 and 2020),
- External shocks, such as major funding changes, new requirements (GAO, 2010), bid protests with associated litigation (Amara and Franck, 2021), and
- "Acts of God" (such as hurricanes, Werner, 2019).

More Near-Universal Scheduling Complications: Managed Processes & Outside Observers

TIME TO COMPLETE	PROBABILITY OF TASK COMPLETION TIME	
	TASK M	TASK N
2	.2	.2
4	.6	.6
6	.2	.2



Program Management "Trade Space" One Simple Example



Realistic schedule estimates don't happen spontaneously

- Initial estimates are influenced by program start optimism **("planning fallacy")**
- More optimistic promises increase likelihood of winning the contact; i.e., those optimists are incentivized to be optimistic
- After source selection, it becomes harder to enforce those promises **("fundamental transformation")**

Schedules & Complexity

Complexity as Fundamental Schedule Problem

- The challenge of defining schedule complexity
- The challenge of finding schedule complexity
- The challenge of measuring schedule complexity
- The challenge of addressing schedule complexity

Project complexity is defined as a system consisting of many varied interrelated parts. It can be operationalized in terms of differentiation and interdependency*

*Baccarini, D. (1996). The concept of project complexity--a review. *International Journal of Project Management*, 14(4), 201-204.

Schedule Complexity

- Book notes there are Fundamental Differences between Dollars and Time:
  - Metrics
    - Time (e.g., Months)
    - Dollars
  - Why Does This Matter?
    - Dollars Can Be Moved from one task to another—underruns and overruns can potentially balance out
    - Time Cannot Be Moved from one activity to another—no balancing
  - Cost is complicated; Schedule is Complex!

*Book, S. A. (2002). *Schedule Risk Analysis: Why It is Important and How to Do It*. Proceedings from Ground Systems Architectures Workshop GSAW, MCR Inc.

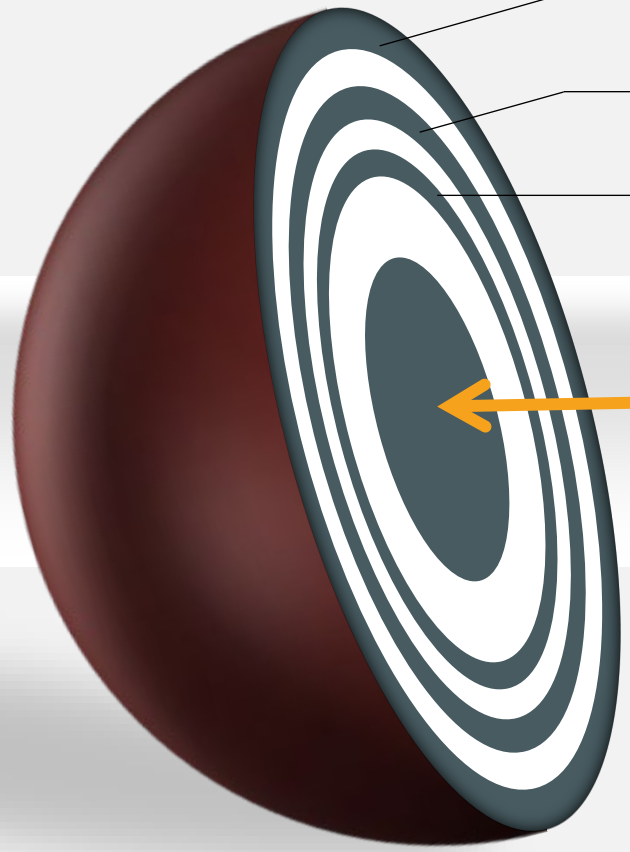
Time is more complex than money*

- A Development Program is a System
  - Inputs--outputs
  - Many interdependent, individual activities arranged in a Network
- A dynamic, unstable metric in a dynamic, unstable system**

*Book, S. A. (2002). *Schedule Risk Analysis: Why It is Important and How to Do It*. Proceedings from Ground Systems Architectures Workshop GSAW, MCR Inc.

**San Cristóbal, J. R., Carral, L., Diaz, E., Fraguela, J. A., & Iglesias, G. (2018). Complexity and Project Management: A General Overview. *Complexity*, *2018*, 1-10. doi:10.1155/2018/4891286

Schedule Complexity



Structural

Uncertainty

Dynamic

Socio-Political

System**

Project (Weapon Systrem

Cost, Schedule and Performance

*After Sheard and A. Mostashari, "A complexity typology for systems engineering," *Syst. Eng*, 2009.

**Williams, T. (2002). *Modelling complex projects*. John Wiley & Sons Inc. Retrieved from http://books.google.com/books?id=NYAeAQAAIAAJ&q=intitle:Modelling+complex+projects&dq=intitle:Modelling+complex+projects&hl=&cd=1&source=gbs_api

Dimension of complexity	Reference
- Uncertainty about the scope of the project	Tatikonda & Rosenthal (2000); Maximiano (2002; 2010); Turner & Cochrane (1993); Remington et al. (2009); Scranton (2008); Williams (1999); Baccarini (1996); Shtub et al. (1994).
- Uncertainty about the product of the project	Tatikonda & Rosenthal (2000); Maximiano (2002; 2010); Turner & Cochrane (1993); Remington et al.
	(2009); Scranton (2008); Williams (1999); Baccarini (1996); Shtub et al. (1994).
- Significant change in the scope of the project during its implementation	Geraldi (2007); Geraldi & Adlbrecht (2007); Remington et al. (2009); Williams (1999); Fitsilis (2009); Turner & Cochane (1993).
- High difficulty to achieve performance goals	Williams (1999); Maximiano (2002); Tatikonda & Rosenthal (2000); Baccarini (1996); Fitsilis (2009).
- High number of stakeholders with influence on the project	Williams (1999); Remington et al. (2009); Fitsilis (2009).
- High interdependence between firms involved in the project.	Baccarini (1996); Williams (1999); Geraldi (2007); Remington et al. (2009); Maximiano (2010); Fitsilis (2009).
- Novelty of the technology	Baccarini (1996); Tatikonda & Rosenthal (2000); Fitsilis (2009); Williams (1999); Geraldi (2007); Remington et al (2009).
- High interdependence between the technologies	Geraldi (2007); Geraldi & Adlbrecht (2007); Remington et al. (2009); Williams (1999); Remington (1996); Pollack, 2007; Baccarini (1996); Fitsilis (2009); Tatikonda & Rosenthal (2000); Ireland (2007); Maximiano (2010).
- High multidisciplinary	Baccarini (1996); Maximiano (2002); Geraldi (2007); Geraldi & Adlbrecht (2007); Fitsilis (2009).
- Large number of different activities to be performed	Baccarini (1996); Williams (1999); Fitsilis (2009).

Yugue, R. T. & Maximiano, A. C. A. (2012). Project Complexity and Management Processes. Paper presented at PMI® Research and Education Conference, Limerick, Munster, Ireland. Newtown Square, PA: Project Management Institute.

Finding Complexity

- Acquisition Data—but will you know it when you see it?
  - What is the determinant of complexity in the acq data
- Finding "Structural knowledge"
  - How the variables in a system (schedule) are related and influence one another*
  - Schedule Delay Factors
- The "unthinking application of a sequence of actions we have once learned"
- How do you measure it?

*Dörner, D. (1996). *The Logic Of Failure*. Basic Books. Retrieved from http://books.google.com/books?id=UrjHjgEACAAJ&dq=intitle:The+Logic+Of+Failure&hl=&cd=1&source=gbs_api

A Complexity Assessment Tool*

Complexity Assessment Tool						
Parameter	Low <25 pts	Medium <50 pts	High <75 pts	Very high <100	Weight	Total complexity index
Size	$<10M	$10-99M	$100-500M	>$500M		
Project Duration	<1 yr	<3 yr	<7 yr	>7 yr		
Ratio Budget/ Duration						
Organizational	PdM	PM	PM	PEO		
Budget	Yes	Some	Little	First Time		
Risk	Low	Med	High	Very High		
Technical Complexity	Low	Med	High	Very High		
Technological Maturity	Very High	High	Med	Low		
Dynamics	No	Little	Some	Yes		
Human Dimension	Component	Subsystem	System	SOS		
Number of contr/ subs	<3	< 5	< 7	>7		
Software						
Total						

* After Thamhain, H. J. (Ed.). (2014). *Managing Technology-Based Projects*. Hoboken, NJ, USA: John Wiley & Sons.

So What

- Contemporary defense acquisition programs are inherently complex in many dimensions
  - … from technical novelty to the number of pages in a contract
- The people involved make them more complicated
- Bottom Line—We need:
  - More data
  - Different Data (beyond the historical approach)
  - Better methods to understand (and predict)

"'Catastrophes' seem to hit suddenly, but in reality, the way has been prepared for them. Unperceived forces gradually eat away at the supports necessary for favorable development until the system is finally unable to resist any longer and collapses."
Dietrich Dörner, The Logic of Failure

Questions