Cost and Risk Impacts of the New DOD 5000 Defense Acquisition Framework

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Objectives

- Highlight some consequences of selected changes in the DOD 5000.02 Policy
  - *The focus of inquiry is centered around the changes impacting the Technology Development phase of the acquisition life cycle*
- Use life cycle modeling and cost estimation research results to facilitate the analysis

Outline

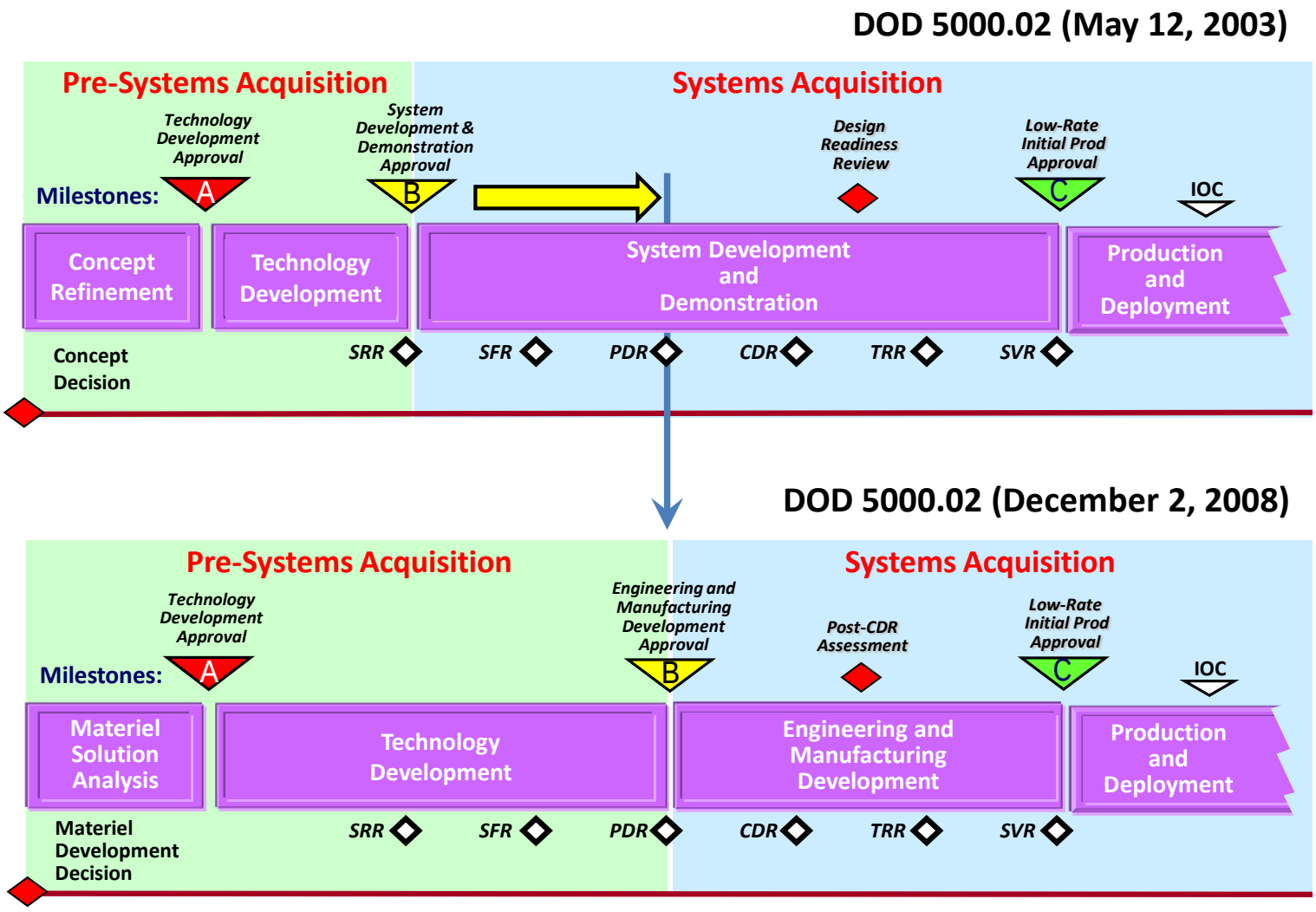
- Major Changes in the Technology Development phase
- Research Methodology
- Constructive Systems Engineering Cost Model (COSYSMO)
- Effort Distributions for the “Old” and the “New” DOD 5000.02
- Analysis
- Conclusions
- Acronyms
- References

Major Changes in the Technology Development Phase*

- "The Technology Development Strategy and associated funding shall provide for two or more competing teams producing prototypes of the system and/or key system elements prior to, or through, Milestone B"
  - *The new policy explicitly calls for competitive prototyping*
- Preliminary Design Review (PDR) conducted for candidate designs and PDR report provided to the Milestone Decision Authority (MDA) at Milestone B
  - *The new policy substantially expands the scope of the Technology Development phase*
- For Major Defense Acquisition Programs (MDAPs) Milestone B certification needs to be provided to the congressional defense committees
  - *The new policy substantially increases the weight and visibility of the Milestone B decision*

**** Source: [DOD 2008]***

PDR Conducted at Milestone B



The Rationale Behind the Changes

- Selected aspects of the discussed changes were proposed earlier in the 2006 Defense Acquisition Performance Assessment (DAPA) report*:
  - *For Acquisition Category (ACAT) I and II programs, create contract terms and conditions that require formal subcontractor level competition instead of internal make-or-buy assessments by the prime*
    - According to the report, this higher level of visibility would allow the government to better understand the technical and management risks of the prime contractor's plans
  - *Reposition the Milestone B decision to occur at PDR*
    - According to the report, the maturity of the designs at this phase would allow more realistic program cost determination
    - Industry and Government would be in a better position to agree on a high confidence cost estimate for the desired capability
    - Source Selection Authorities would have a competitive range available to consider the proposals' affordability

Source: [DAPA 2006]

Research Methodology

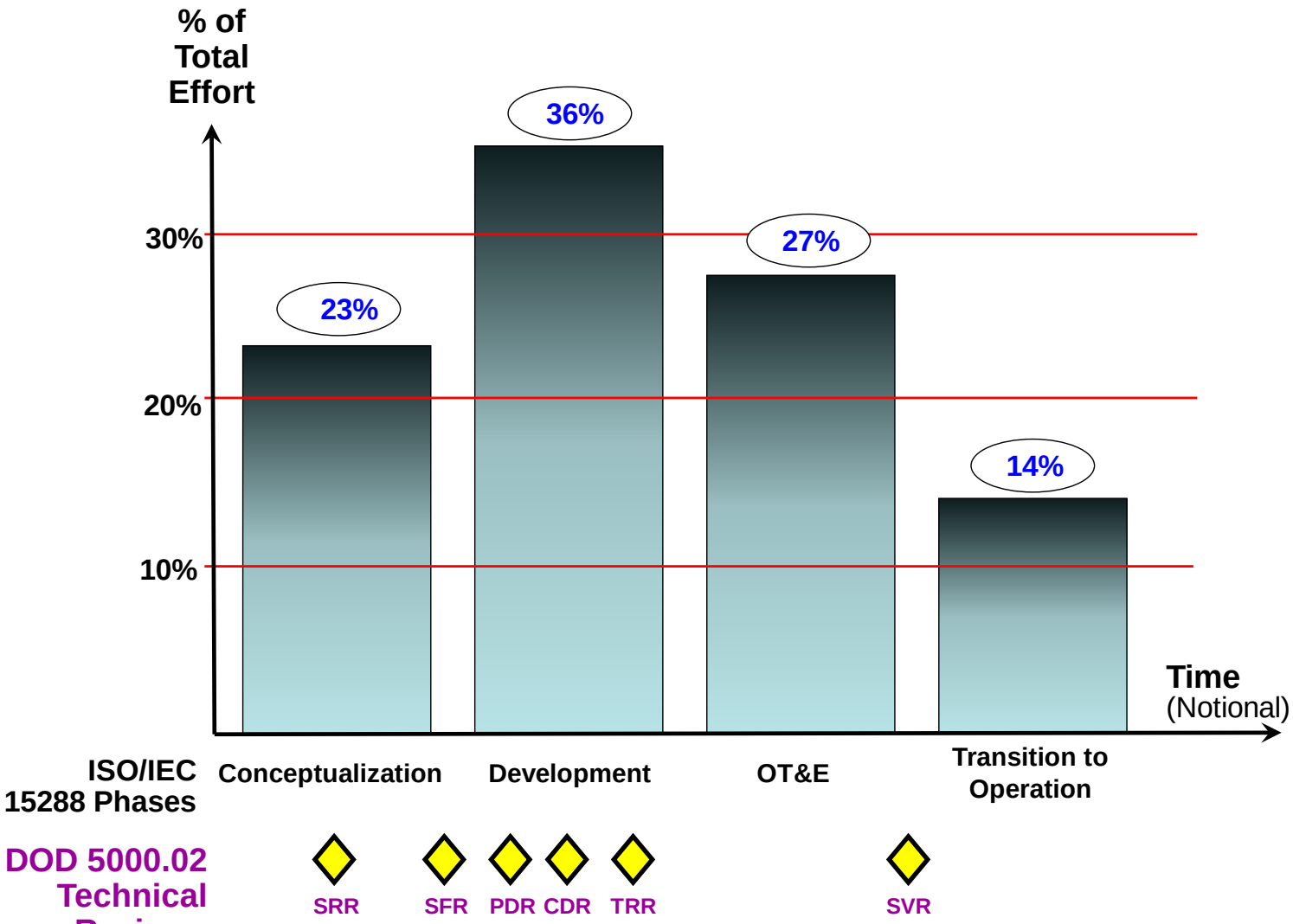
- Determine the systems engineering effort distribution using the Constructive Systems Engineering Cost Model (COSYSMO)
- Map the DOD 5000.02 Technical Reviews to the systems engineering standard's life cycle phases
- Using the COSYSMO effort distribution, model the total systems engineering effort for an acquisition using a two-contractor example, for both the old and the new versions of the DOD 5000.02 acquisition life cycle models
- Evaluate results, generalize for more than two competing contractors

Detour: COSYSMO

- What is COSYSMO?
  - *COSYSMO is a parametric estimation model to estimate how much systems engineering effort, in terms of person months, should be allocated for successful conceptualization, development, and testing of a large-scale system [Valerdi 2008]*
  - *Originally developed at the University of Southern California*
  - *COSYSMO adapted the ISO/IEC 15288 standard's phases* as the underlying life cycle model*

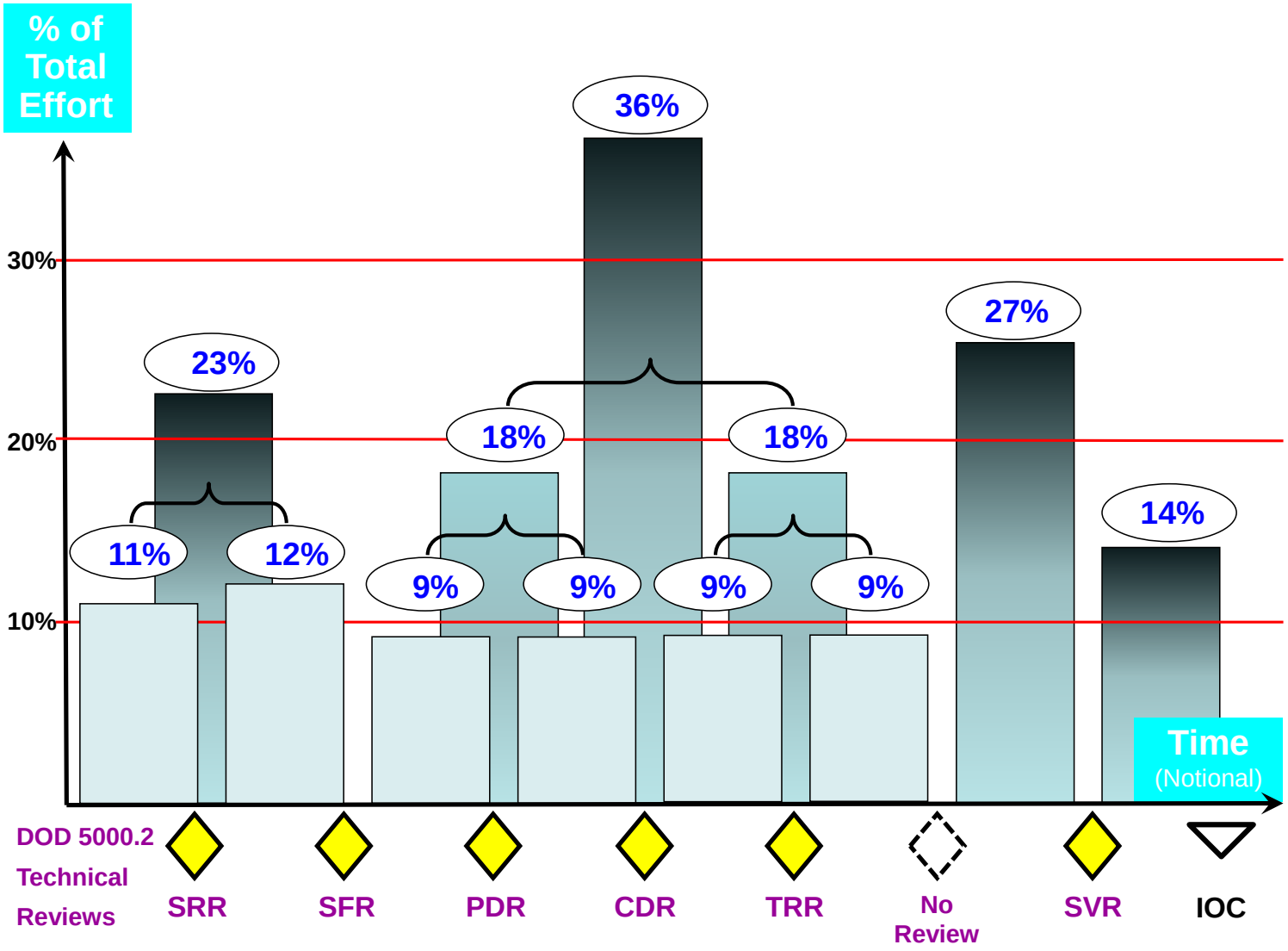
**** For more details on the standard see [ISO/IEC 2002]***

COSYSMO Systems Engineering Effort Distribution*



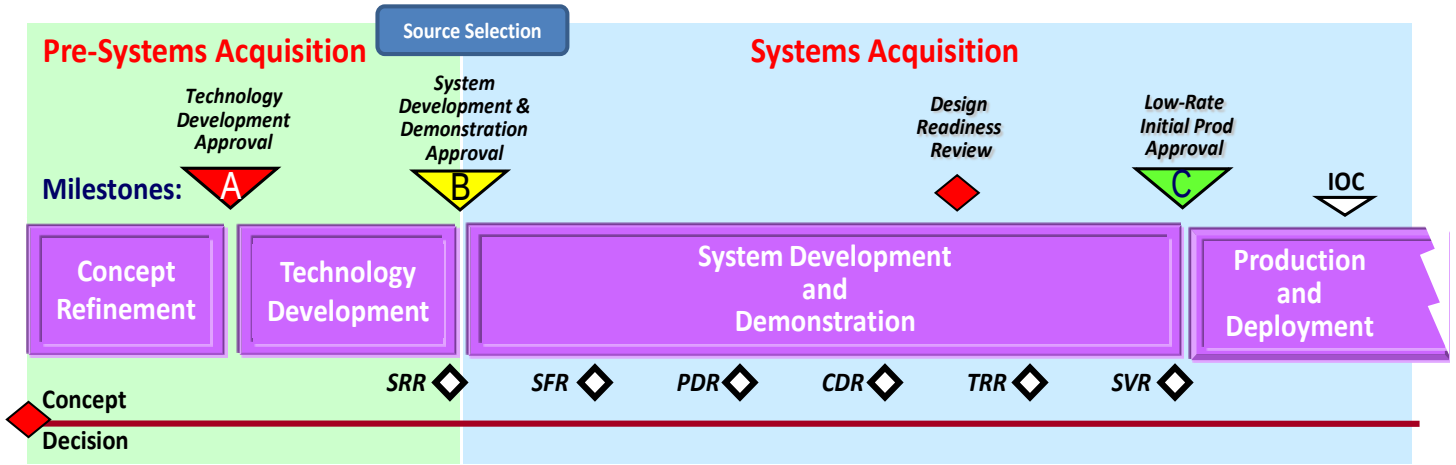
**** For sake of simplicity, standard deviation of effort values is not shown***

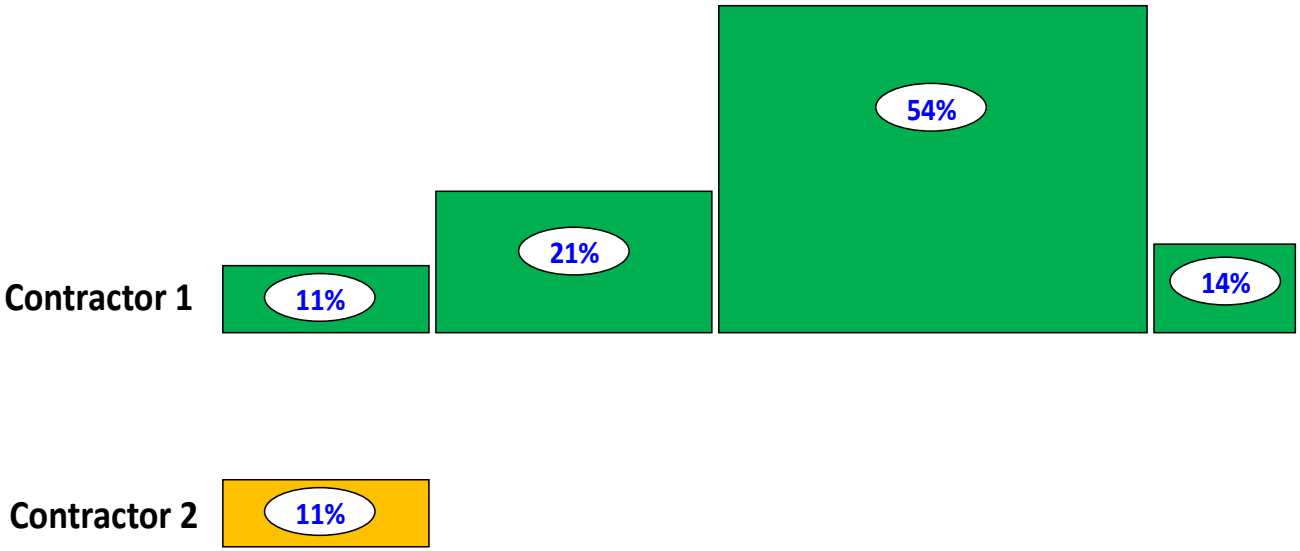
Approximation of Effort Between Technical Reviews



This approximation is not part of either the standard or COSYSMO

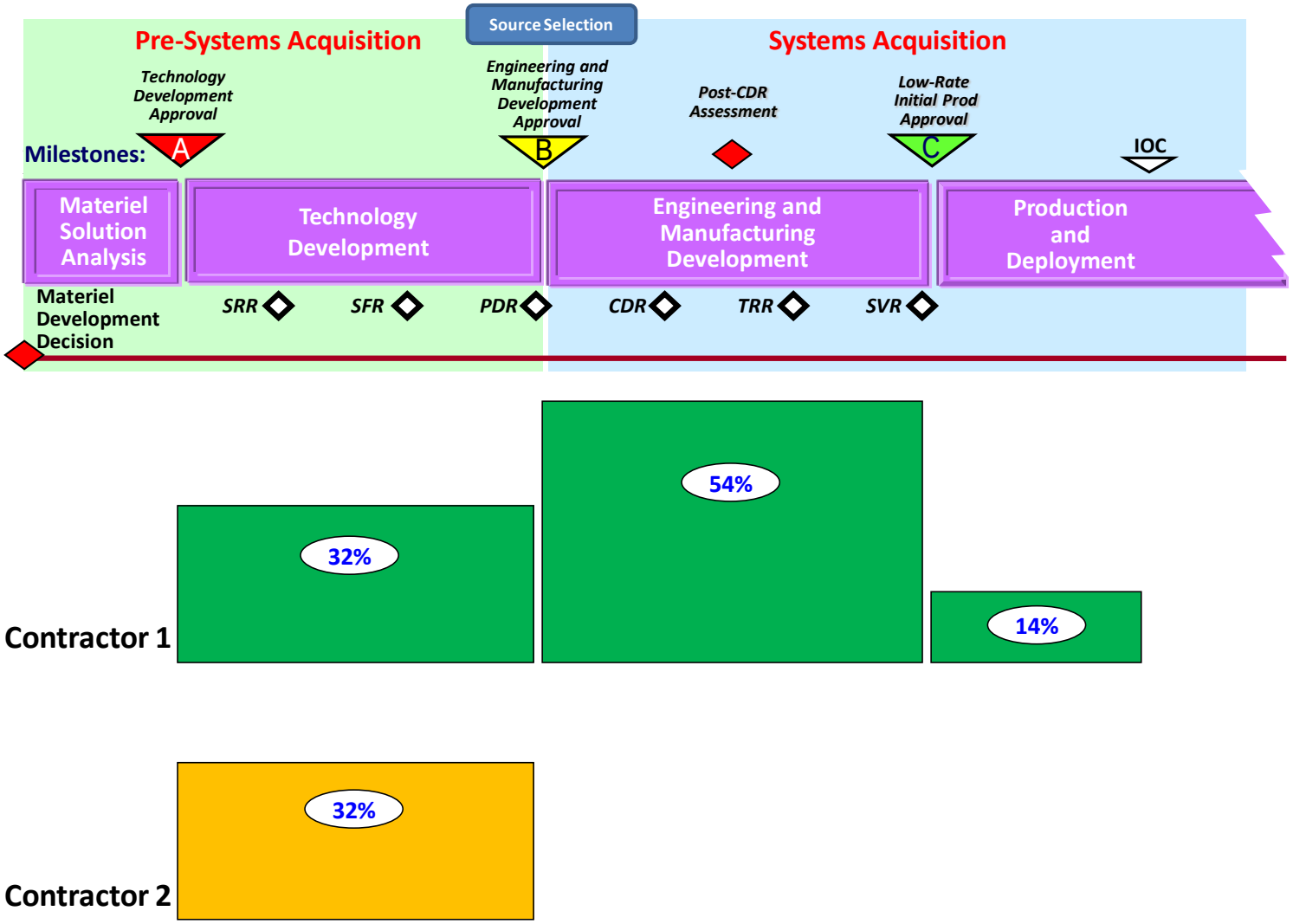
Effort Distribution for DOD 5000.02 (May 12, 2003)





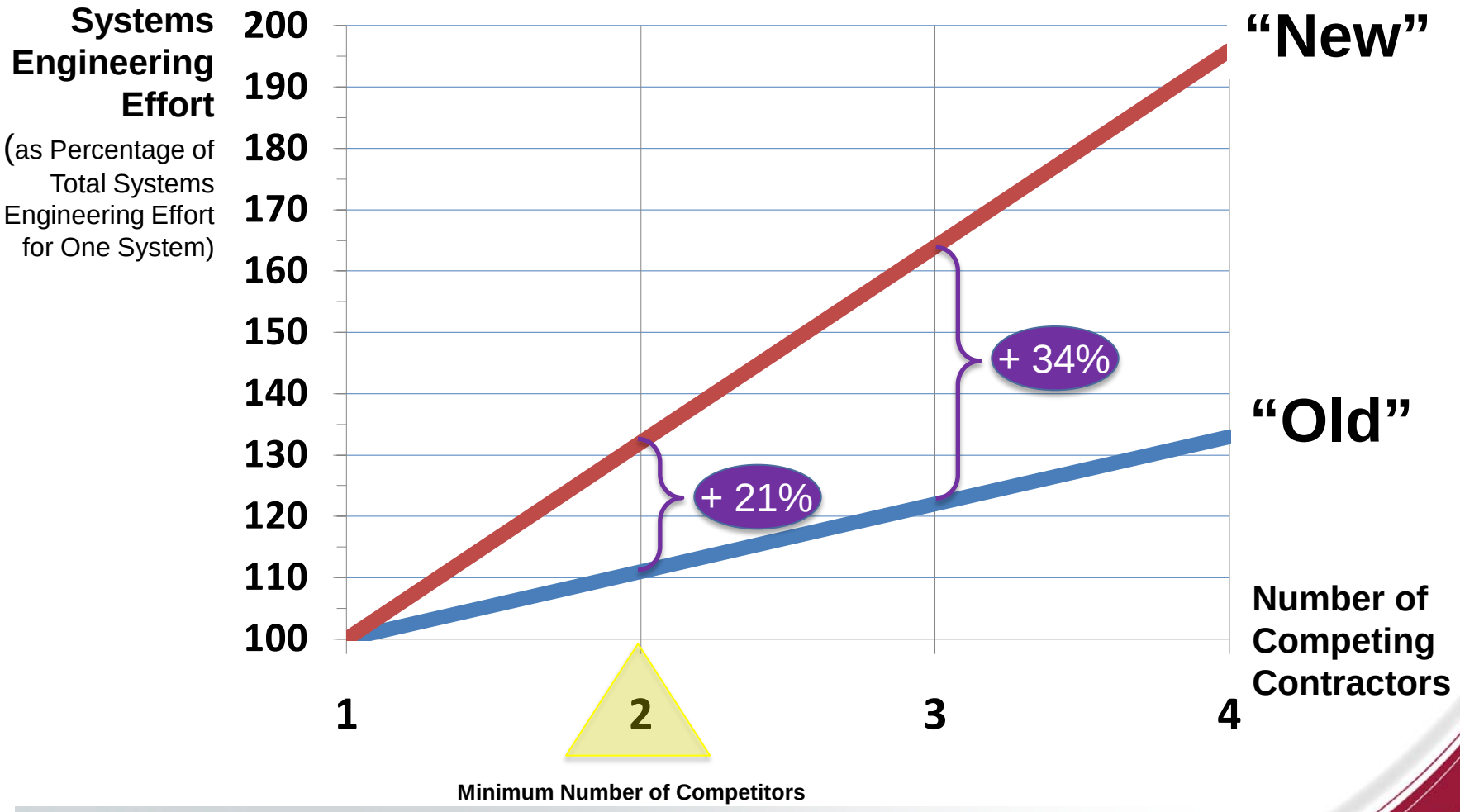
Note that the minimum effort for the overall acquisition is 111% of a single system's total effort since at least two contractors must compete

Effort Distribution for DOD 5000.02 (December 2, 2008)



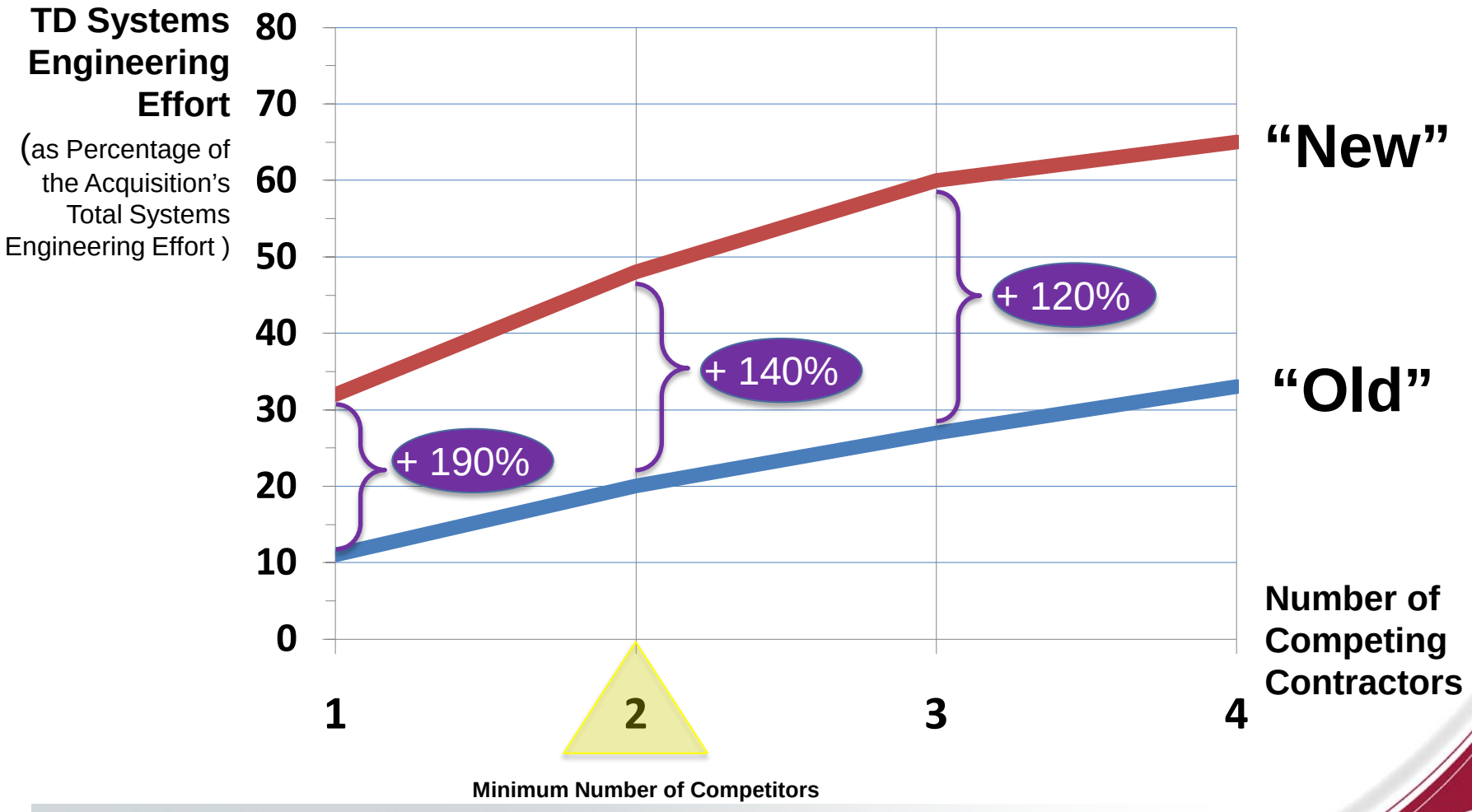
See analysis of impact on the following slides

Contractors' Systems Engineering Effort



Moving Milestone B increases the overall Systems Engineering effort

Technology Development Systems Engineering Effort



Analysis

- DOD and Government Accountability Office (GAO) Perspective
  - *Cost*
    - Since the program baseline is now established after PDR, the cost and duration of acquisitions might be expected to decrease
    - However, the overall cost of acquisitions, particularly the costs associated with the initial systems engineering effort involving multiple contractor teams, may significantly increase
    - Note: If the initial costs are <u>not</u> significantly increasing, that would mean that each team is receiving less funding than they would have received to get through PDR prior to the policy change. How can they be expected to do more risk reduction up front with less money up front?
    - The balance between Pre-Acquisition and System Acquisition has changed; the weight of Technology Development has increased
      - *Cost Analysis Improvement Group (CAIG) estimates, budgeting plans and budgeting effectiveness evaluations need to take this into account*
  - *Program Risk*
    - The longer, extended TD phase is likely to have multiple impacts:
      - *Reduction in rework at the back-end of the development life cycle, resulting from more extensive effort at the front-end*
      - *Reduction of program risk, but probably at increased cost and schedule*

Analysis (cont.)

- Program Executive Officer (PEO) Perspective
  - *Program Office effort, leading up to and carrying out source selection, will significantly increase*
    - Program office staffing plans need to take this into account
    - However, due to the financial reality, most likely the government team will just be spread thinner
    - A special challenge in such a competitive environment is that the government team cannot freely communicate with the contractor teams due to fear of protest for steering a contractor to a desired solution.

Conclusions

- Results of modern systems engineering research, particularly COSYSMO, are very useful in evaluating the impact of acquisition processes
- The analysis of selected features of the new DOD 5000.02 showed some of the potential consequences of the instituted changes
- To minimize these consequences, systems engineering analysis should be carried out with consideration of the potential positive and negative impacts
- Various scenarios have been analyzed as part of this research, but actual cost/schedule impacts remain to be seen
  - *The vision for systems during the Pre-A phase may be quite vague; consequently, estimates based on that vision have high levels of uncertainty*
  - *In addition to technical considerations, the gauging of TD funding will be based on various component and/or higher level negotiations*
  - *Both under- and over-estimation of resources for TD can put the program in jeopardy at the MS A and B decision points*

Acronyms

ACAT	Acquisition Category
CAIG	Cost Analysis Improvement Group
CDR	Critical Design Review
COSYSMO	Constructive Systems Engineering Cost Model
DAPA	Defense Acquisition Performance Assessment
DOD	Department of Defense
IEC	International Electrotechnical Commission
IOC	Initial Operational Capacity
ISO	International Organization for Standardization
MDA	Milestone Decision Authority
MDAP	Major Defense Acquisition Program
PDR	Preliminary Design Review
SFR	System Functional Review
SRR	System Requirements Review
SVR	System Validation Review
TD	Technology Development
TRR	Test Readiness Review

References

DAPA 2006	Defense Acquisition Performance Assessment Report, March 2006
DOD 2008	Department of Defense Instruction on the Operation of the Defense Acquisition System, Number 5000.02, 2 December 2008
ISO/IEC 2002	ISO/IEC 15288:2002(E) Systems Engineering – System Life Cycle Processes
Valerdi 2008	The Constructive Systems Engineering Cost Model (COSYSMO), VDM Verlag Dr. Mueller, 2008

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