Trades in CAIV

TOC/CAIV Workshop 99-3

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Outline

- The requirement
- Trade rules
- Trade basics
- Risk in trades

Why *Do* Trade-offs?

- **Ordinary design requires tradeoffs**
- **CAIV requires tradeoffs to an unprecedented level**
  - Trades are the core of CAIV

How can trades be done effectively and quickly?

What are the issues?

Are there tools?

But first, to review the requirement ...

Principles of CAIV Within the DoN

- **CAIV embraces the following fundamental, iterative actions over the life cycle to optimize warfighting capability within affordability constraints and to promote program stability:**
  1. **Establish mission area resource allocations for each resource sponsor community.**
  2. **Determine operational requirements to meet mission needs.**
  3. **Estimate total life cycle costs to satisfy requirements.**
  4. **Project long-range availability of resources in all affected appropriations based on resource sponsor priorities.**
  5. **Assess cost, schedule and performance relationships.**
  6. **Establish aggressive target costs.**
  7. **Identify cost reduction opportunities and tradeoffs to meet aggressive targets.**
  8. **Develop plans, metrics and provisions for managing program execution.**

Principles of CAIV Within the DoN

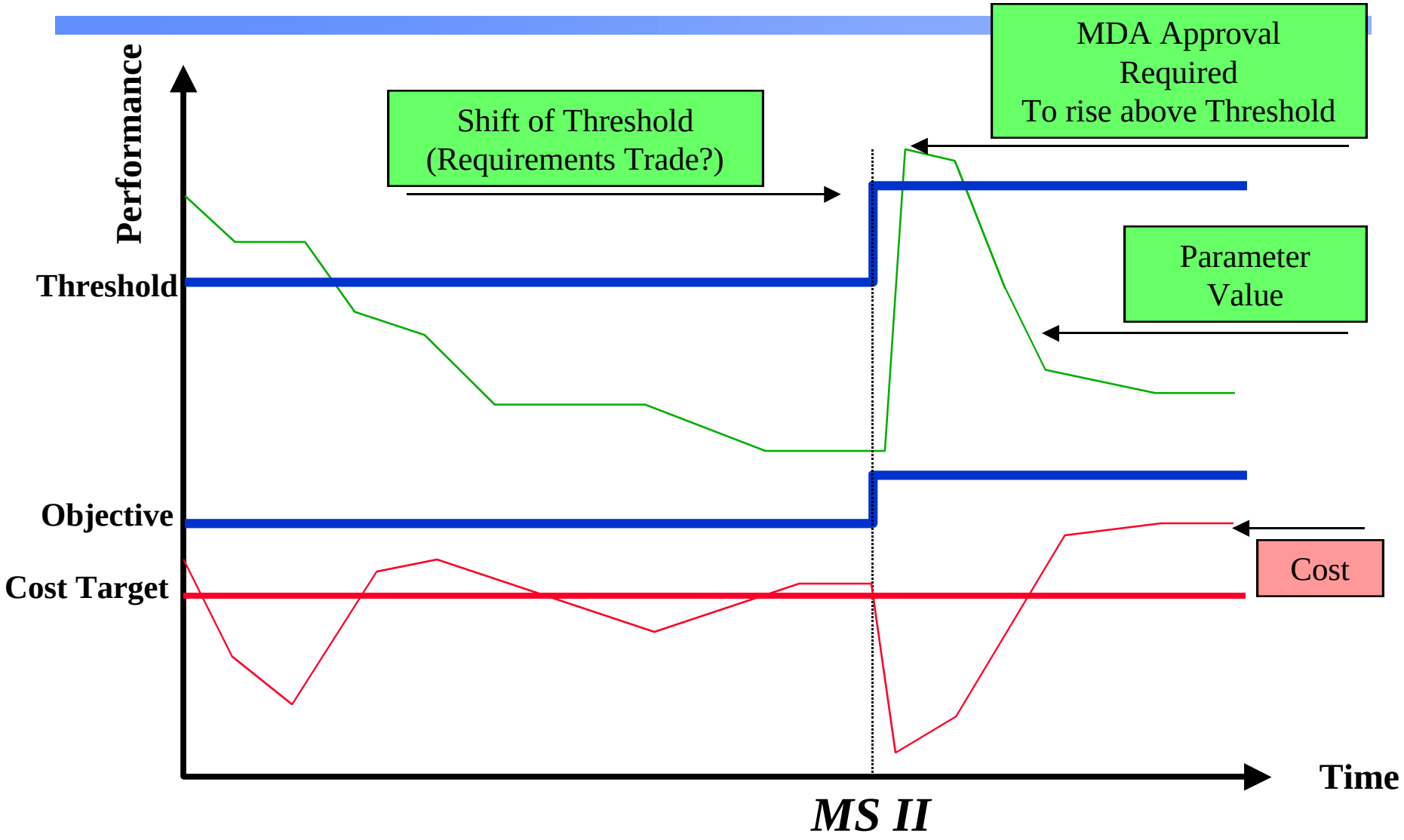
- **CAIV employs a hierarchy of cost reduction activities, expanding the potential trade space. The recommended priority for cost reduction is:**
  - **(1) Processes, activities and technology choices.**
  - **(2) Requirements which do not directly contribute to warfighters' needs.**
  - **(3) Trade-offs that reduce cost while still meeting all operational requirements.**
  - **(4) Cost-performance trade-offs of user requirements resulting in a breach of the approved operational requirement threshold are only to be accomplished as a last resort, with the agreement of the MDA and CNO/CMC.**

Rules for Trades

Trades - Boundaries and Timing

- **Trade bounds:**
  - **Trades between the Objective and Threshold values are within the purview of the PM.**
  - **Outside these values, they are the purview of the MDA - *DoD 5000.2 Ch-3***
- **Trade timing**
  - ***Preparatory* to a Milestone:** **Requirement/Cost trades**
    - **By the Gov't with industry participation**
  - ***During* a phase:** **Cost/Performance trades**
    - **By the Prime with PM participation**
  - **These two trade types are similar in conduct, but can be thought of as first and second steps**

Performance and Thresholds



Trade Basics

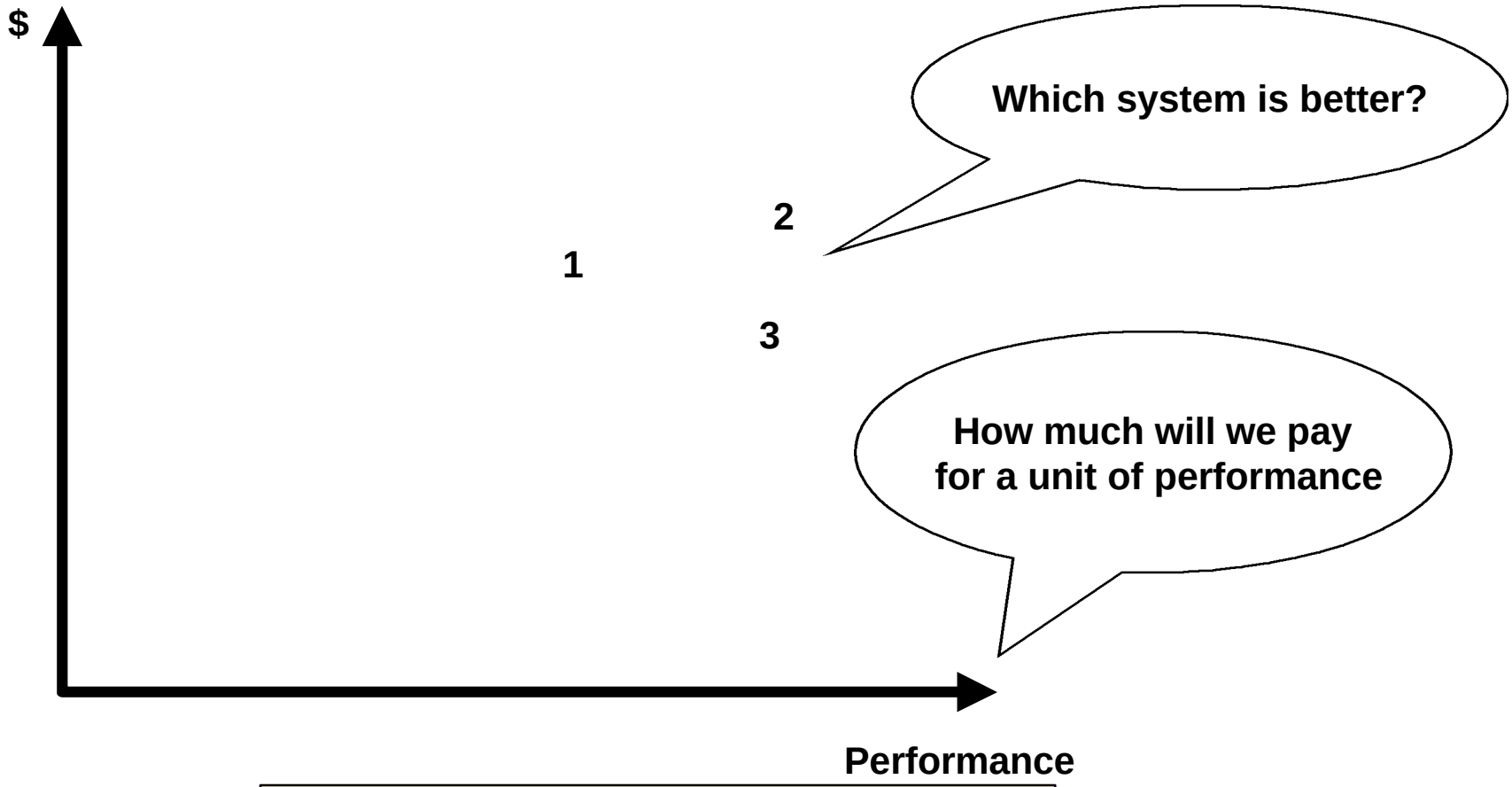
Cost/Performance Trade Challenges

- To trade cost and performance, the two must be compared in some common unit (co-mensurable)
  - This is often impossible in military applications … and is even hard in business … value is notoriously difficult to determine
  - This problem is a classical issue in Operations Research
- As in the conduct of COEAs and AoAs, the practice often is:
  - To compare alternatives with one or the other fixed
  - To adjust one or the other variable to match in all of the alternatives
- Sometimes the comparison is simple, involving strict dominance (e.g., better performance, less cost)
- There are a few basic methods
- But, In difficult cases, military judgment may be necessary
  - *"Less taste ... more filling"*

Cost/Performance Trade Challenges

- **Linkage - To trade, you must be able to show cost for each alternative**
  - **Some alternatives are hard to cost out**
  - **Costs don't change if CER input variables don't include the parameter you changed**
  - **Even if possible, the volume and speed of trades can make linkage hard**
- **Exchange rate - To trade, you must know the dollar value of performance**
  - **What is one knot of speed worth?**
  - **What is the dollar value of greater accuracy**

Linkage and Exchange Rate

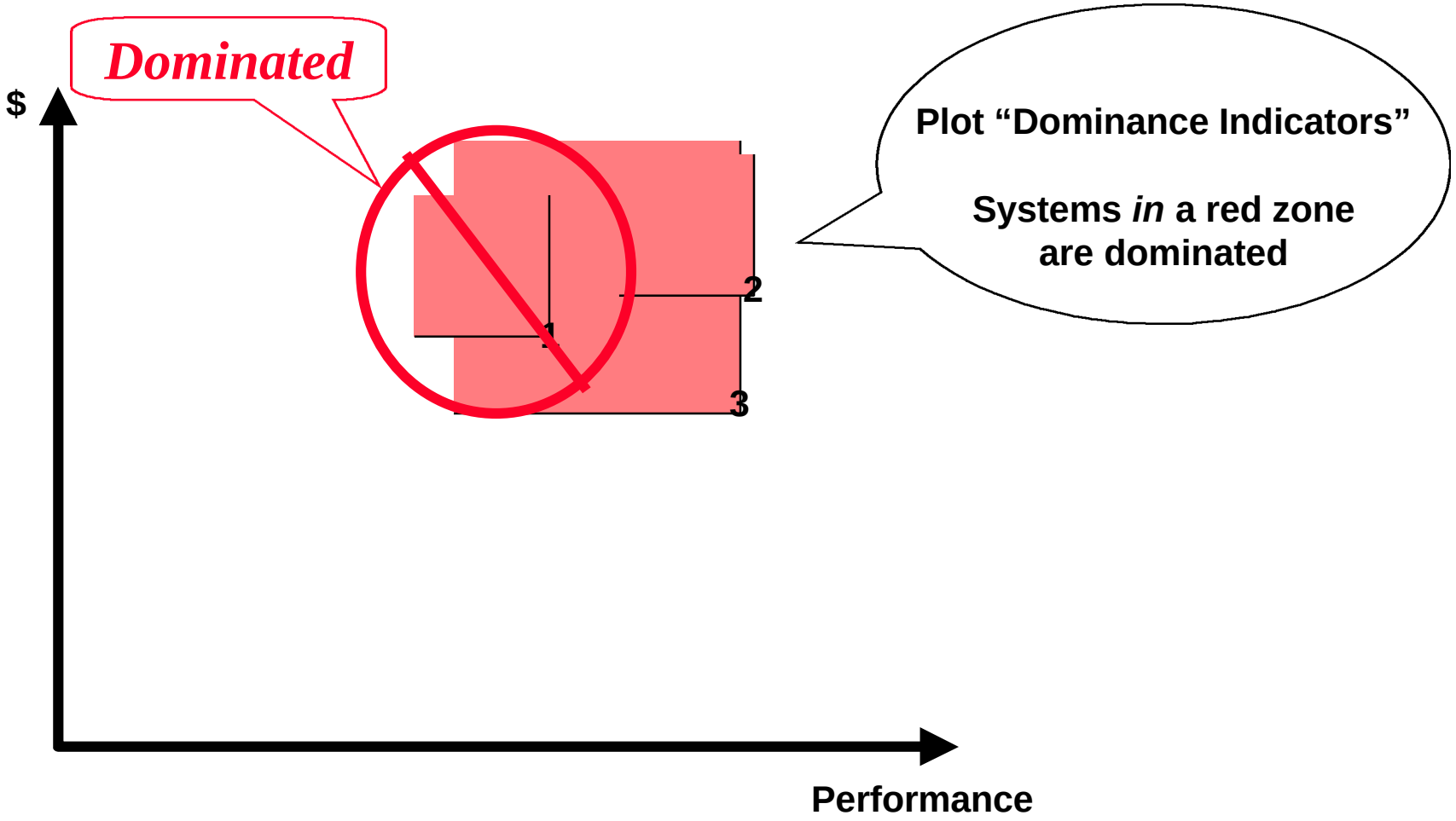


Linkage lets you plot the points
Exchange rates let you choose

Two Basic Methods of Trading

Without establishing the cost/value relationship

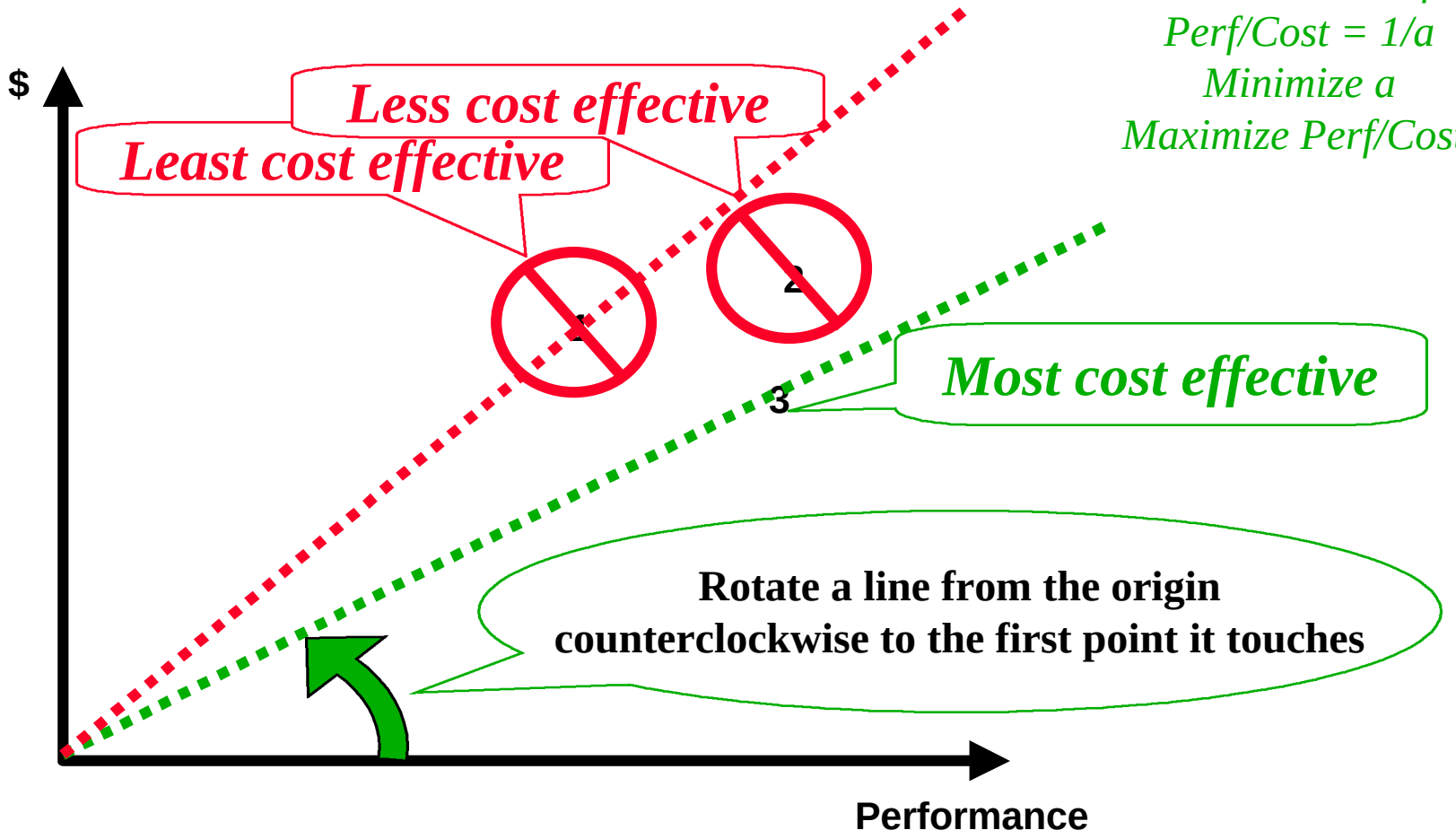
Strict Dominance Without Co-Mensurability



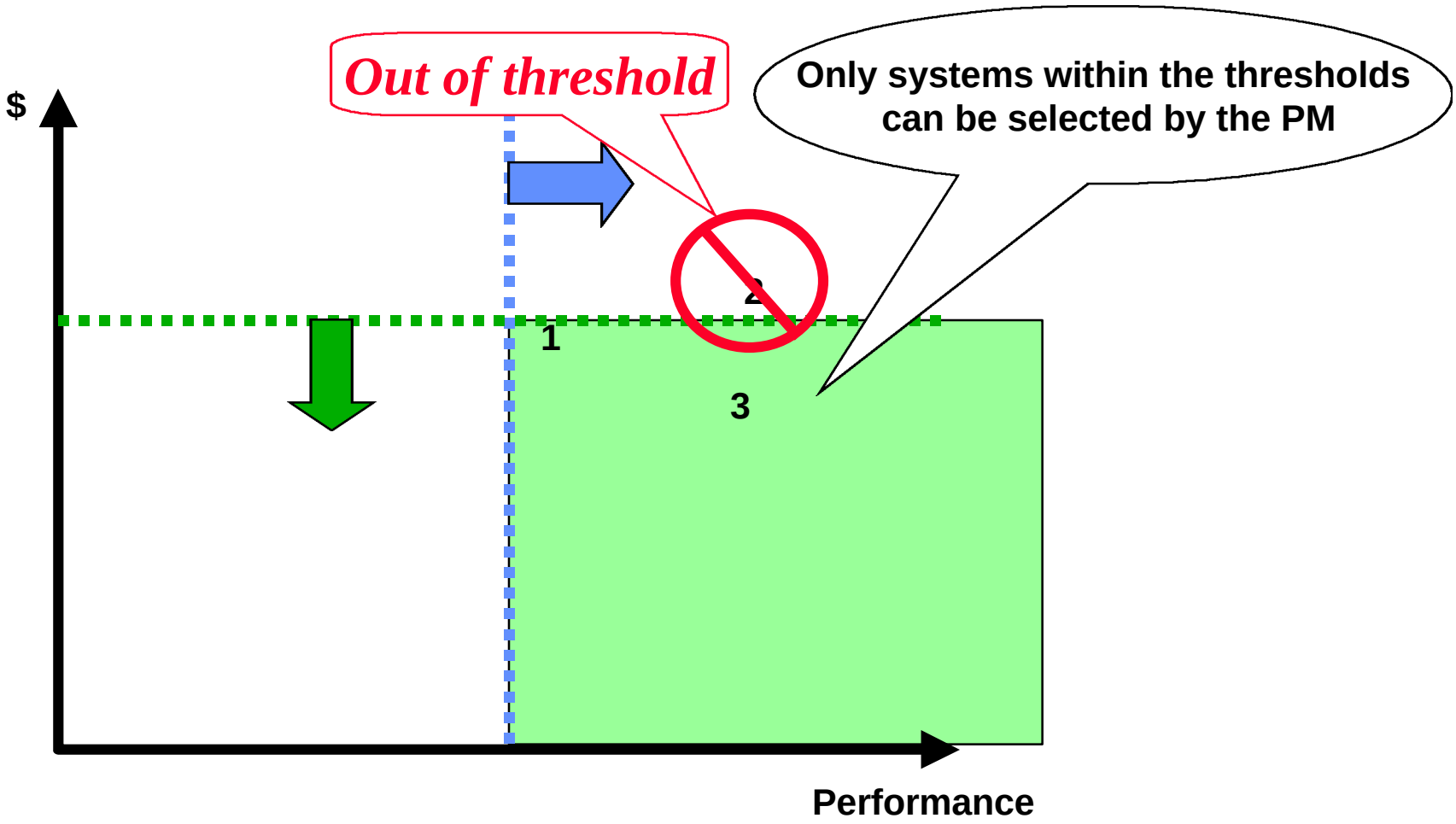
Best "Bang for the Buck"

When Cost is Very Important

*Cost = a * Perf*
Perf/Cost = 1/a
Minimize a
Maximize Perf/Cost



Choosing Within Constraints



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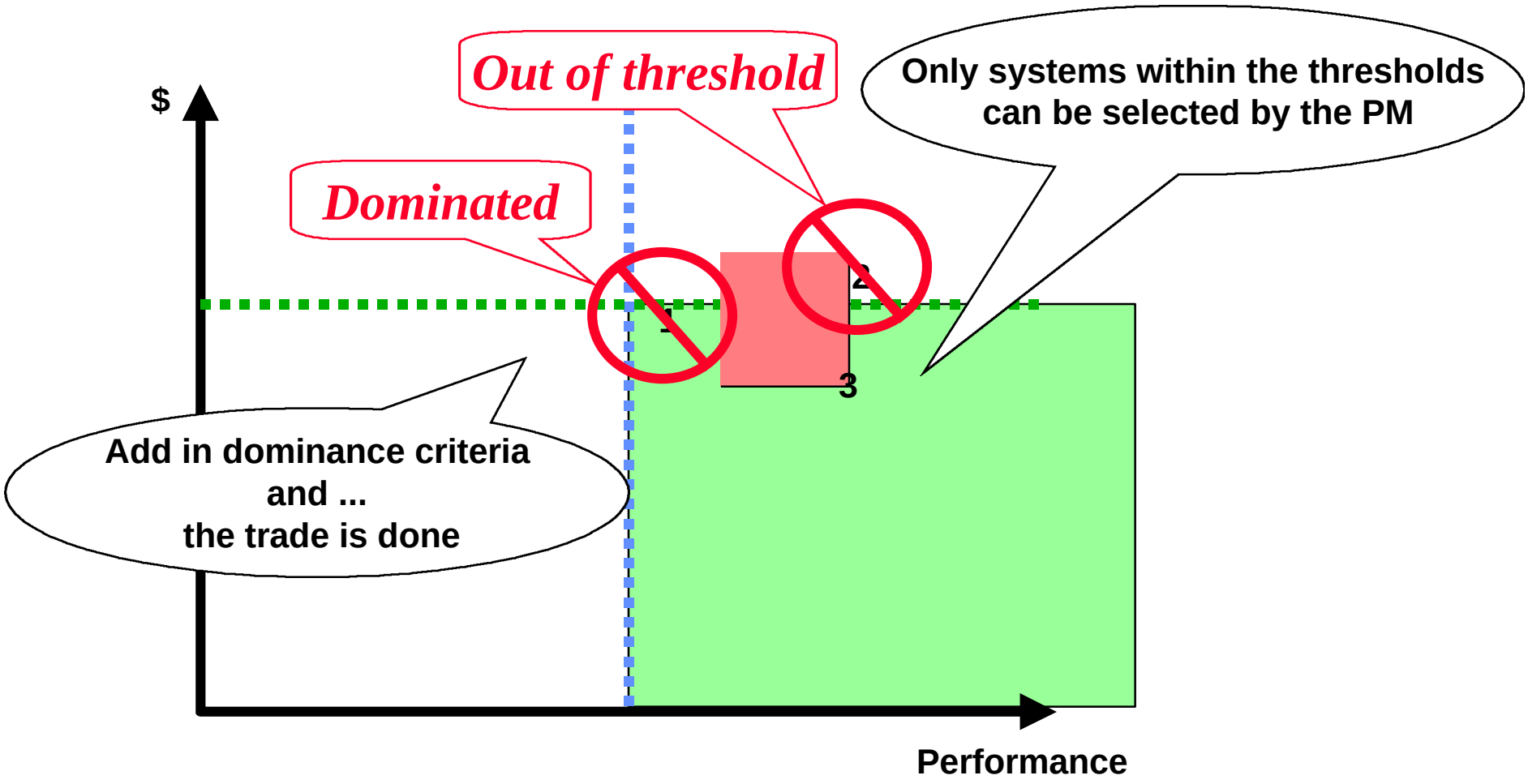
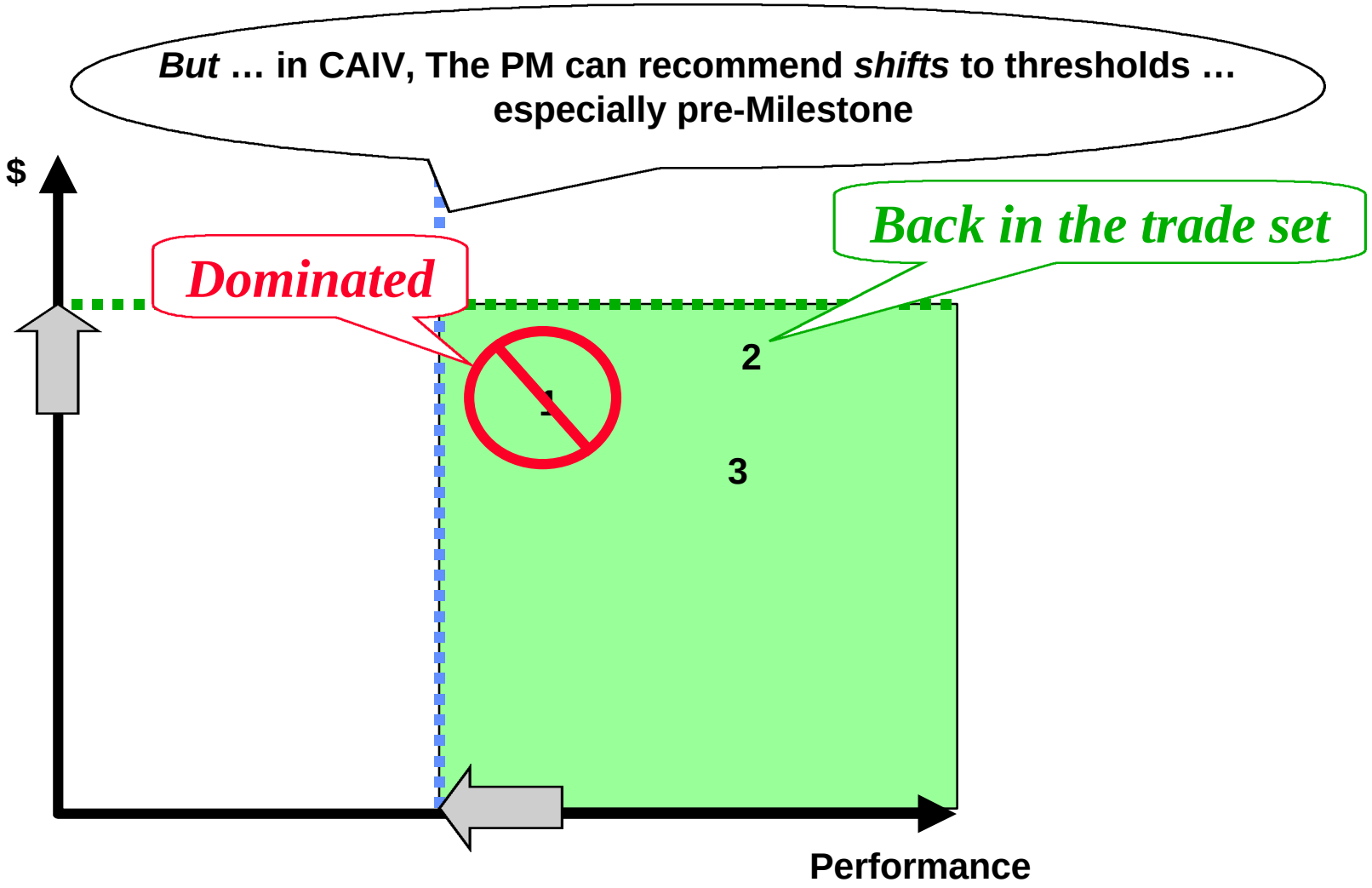
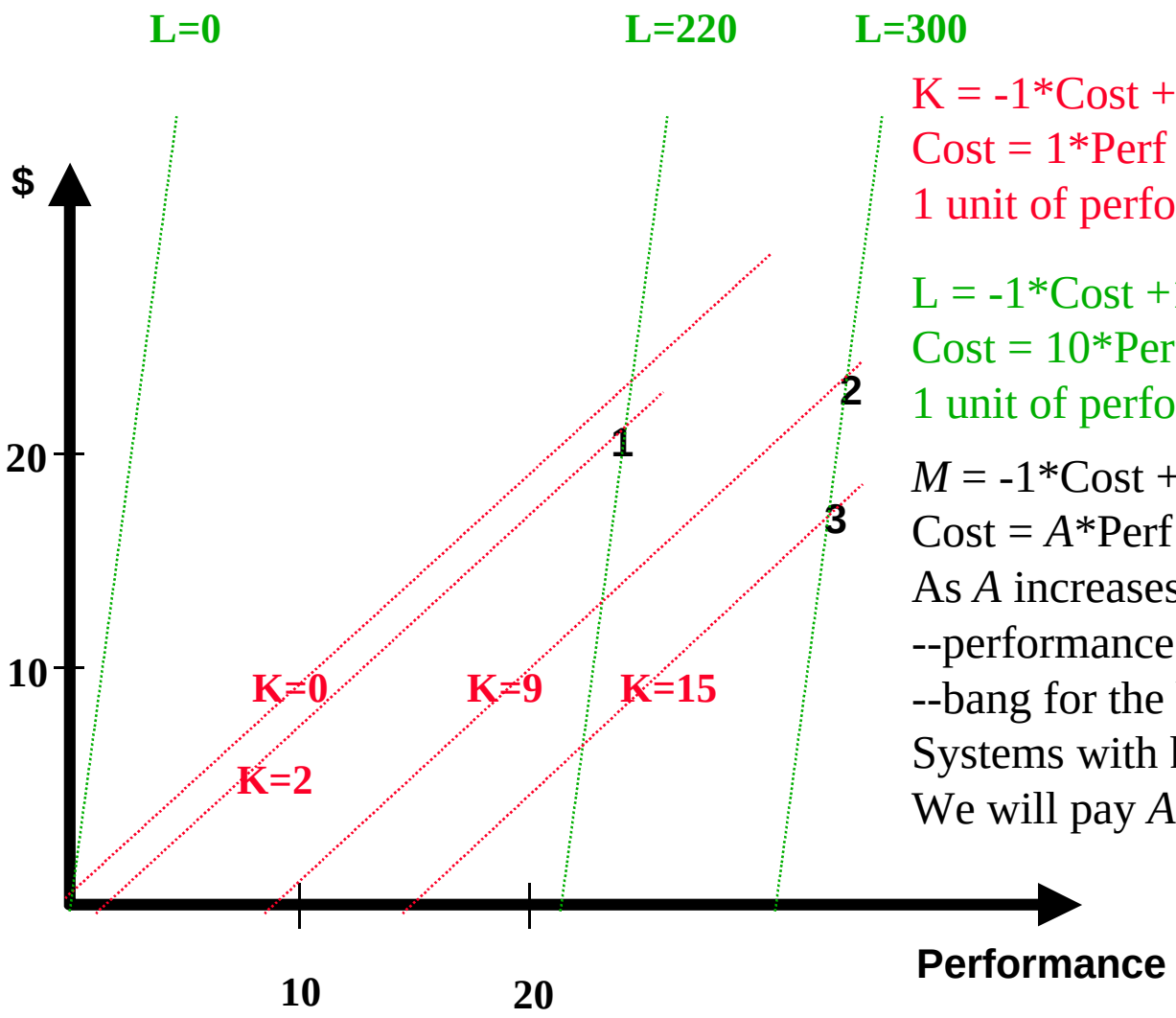


Choosing Within Constraints - Caveat



Exchange Rate

When you know the "Dollar Value" of Performance



K = -1*Cost +1*Perf
Cost = 1*Perf - K
1 unit of performance = 1 unit of cost

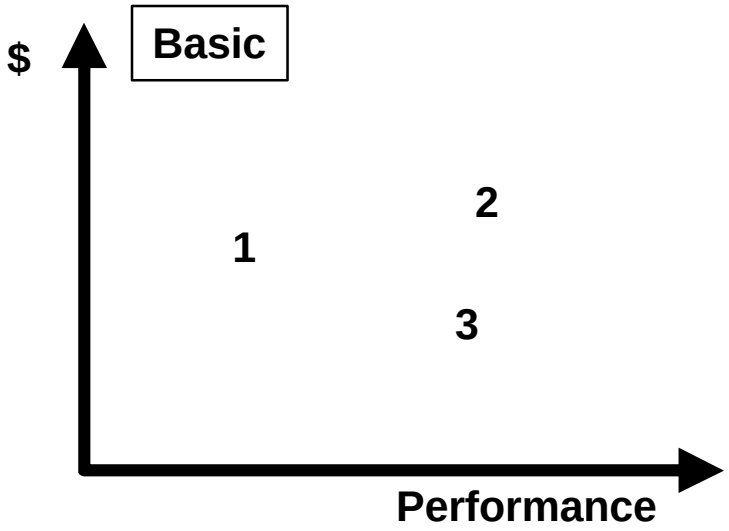
L = -1*Cost +10*Perf
Cost = 10*Perf - K
1 unit of performance = 10 units of cost

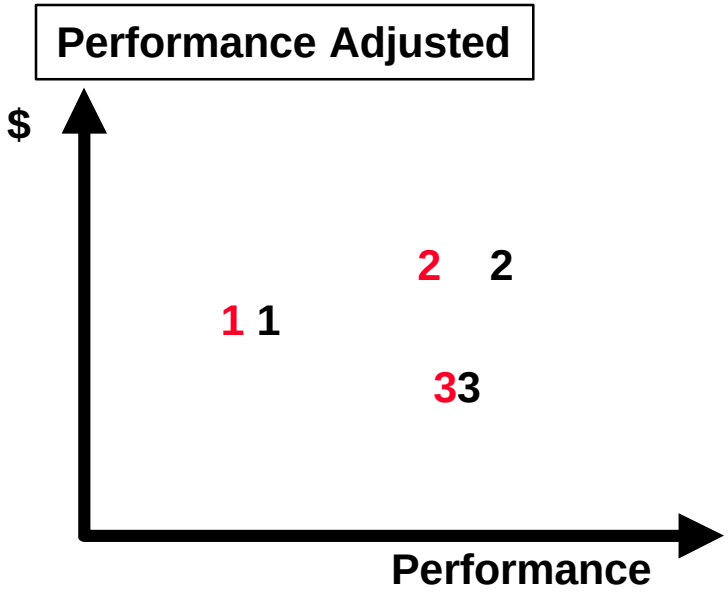
M = -1*Cost +*A**Perf
Cost = *A**Perf - *M*
As *A* increases,
--performance is more important,
--bang for the buck is sacrificed
Systems with higher *M* values are preferred
We will pay *A* dollars per unit of performance

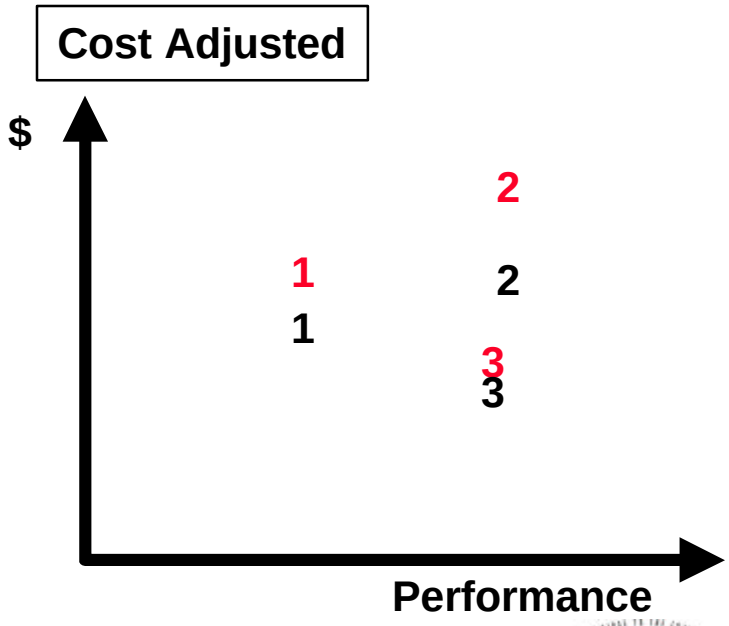
Risk in Trades

- **Risk is a fact of life, and is higher in TOC and CAIV.**
  - **How should it be handled in trades?**
- **In life, we see risks as separate, discrete outcomes:**
  - **A car crash**
  - **A disease**
- **In cost, and Program Management, risk is *a failure to achieve a goal* ... an *un-anticipated value of a metric* we are managing:**
  - **Cost over-run**
  - **Performance shortcoming**
  - **Schedule slip**
- **To handle this sort of risk, adjust the expected value of the metric**
  - **This is simple in concept, and well established in practice**
- **This simplifies our problem:**
  - **Reduces the number of potential variables by one**
  - **Avoids the issue of "non-comensurability" which arises in trading risks and dollars**
    - **A problem already hard enough in cost and performance trades**

Risk Adjustment Illustration







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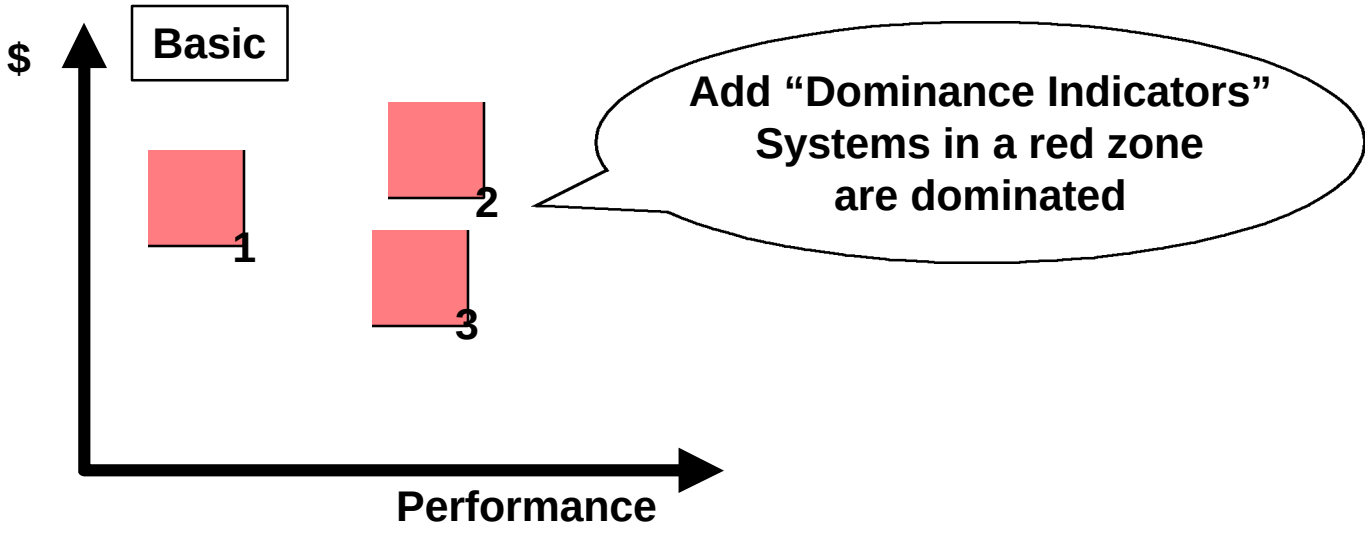

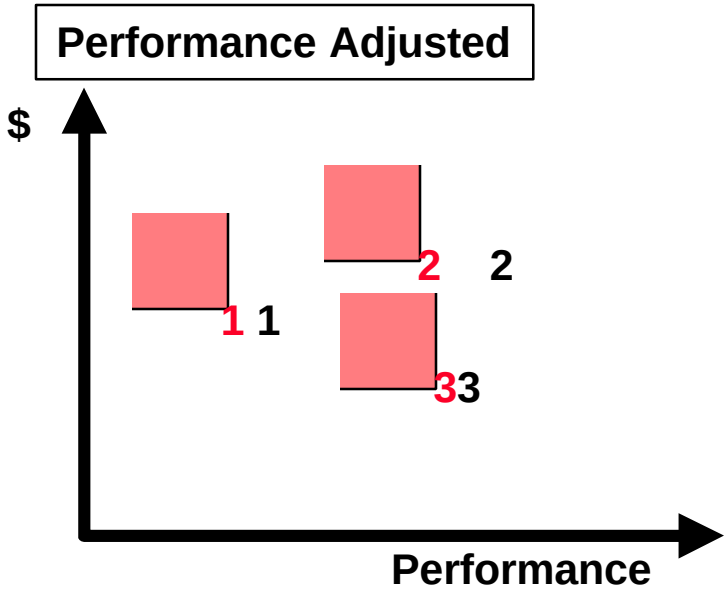

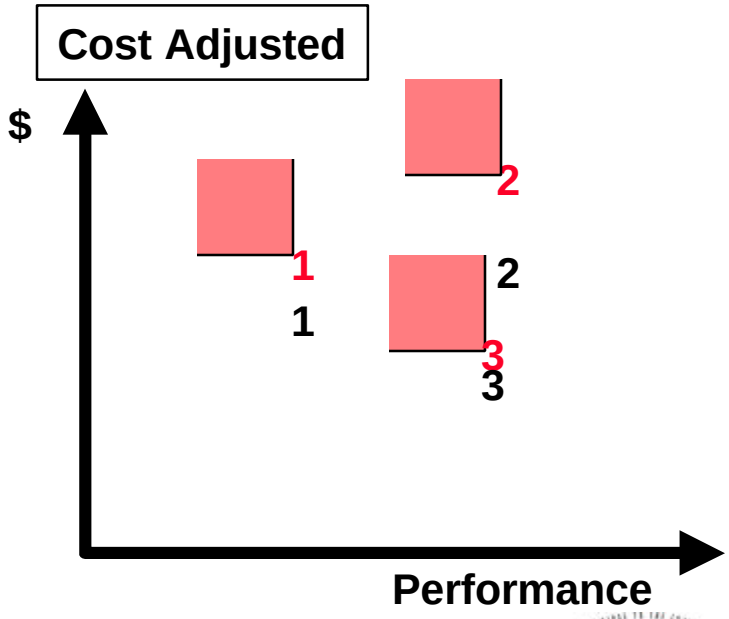

Risk Adjustment Illustration