

A Trade Study Methodology for Technology Insertion

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Client Logo

Booz | Allen | Hamilton

Motivation

Problem Setting

- ▶ Legacy system with aging & outdated technologies and sub-systems
- ▶ Recapitalization not viable or replacement system years away from being ready
- ▶ Additional roles & uses of the system deem additional capabilities are needed to bridge time until legacy system is replaced

Technology Insertion

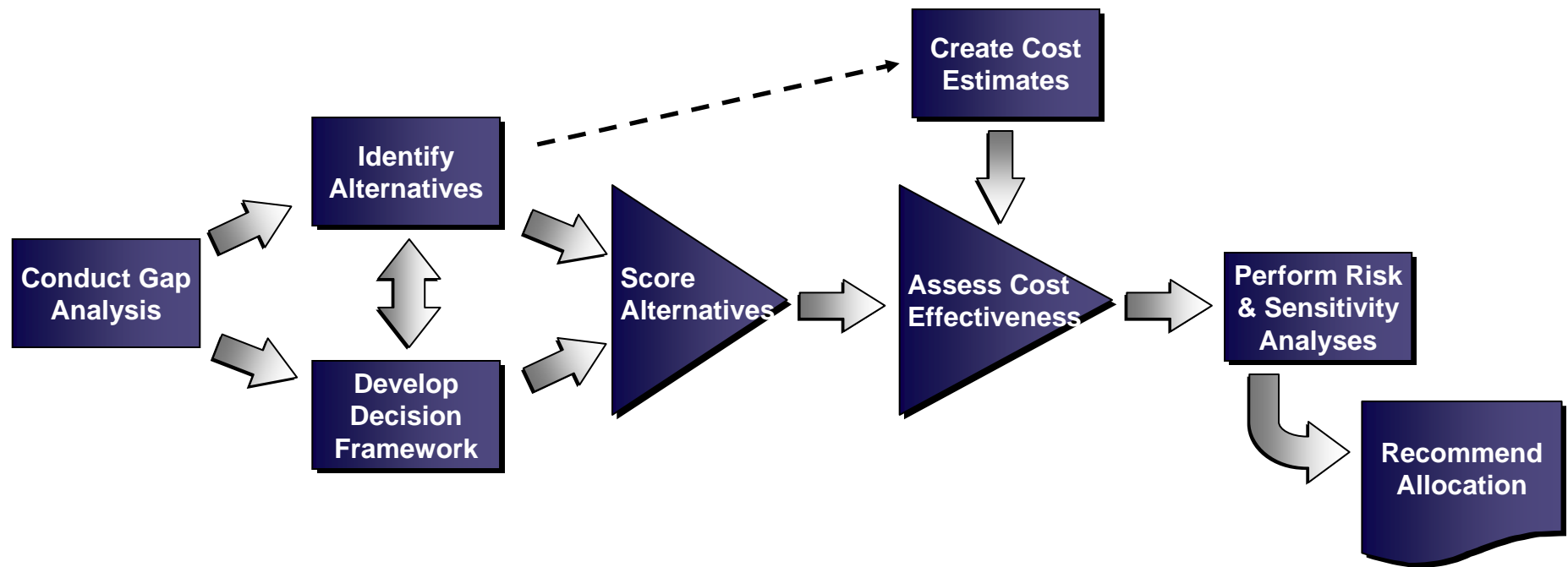
- ▶ Selection of new technologies to be applied to the existing system, providing capabilities to alleviate gaps in requirements

Outline

- ▶ Introduction / Motivation
- ▶ Trade Study Methodology Summary
- ▶ 8 Tasks
 - Description
 - Activities
 - Considerations
- ▶ Summary
- ▶ Questions

Tech Insertion Trade Study Methodology

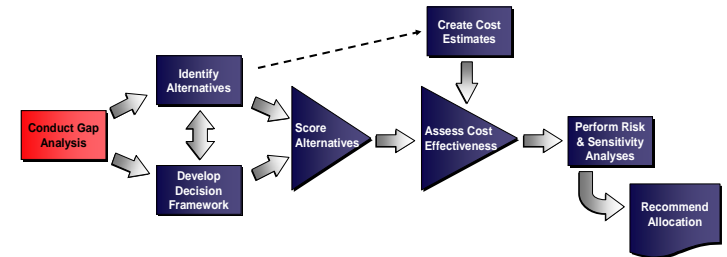
Eight high-level tasks outline the trade study methodology for technology insertion



Tech Insertion Trade Study Methodology Strengths

- ▶ Incorporates multiple analytical elements into one succinct framework, rather than multiple activities often disconnected in time
 - Leverages theories and practices of Operations Research
 - Provides defensible support throughout a system's life cycle
- ▶ Emphasis is placed on making the alternatives development and value hierarchy rooted in the gap analysis
 - Ensures focus is on capabilities to improve the existing system
- ▶ Widely applicable across the government and commercial sectors

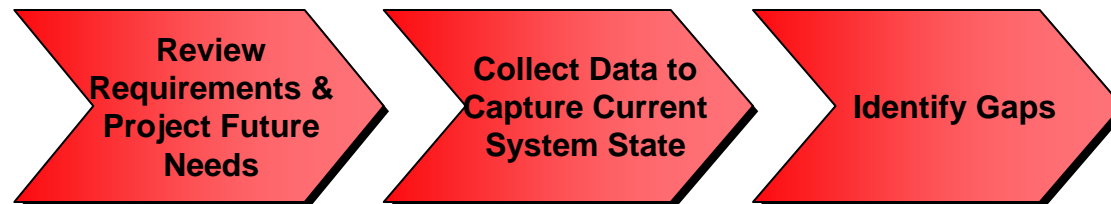
Conduct Gap Analysis



Description

- ▶ An assessment of the current system state with respect to existing (and projected) requirements leading to the identification of specific capabilities where the system is not performing to the level needed

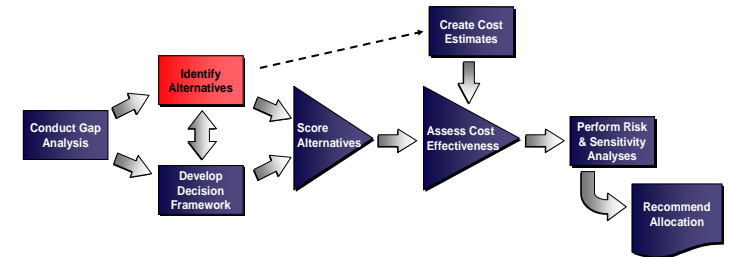
Activities



Considerations

- ▶ Requirements are not always well stated or stated at all and pose difficulties in the characterization of gaps
- ▶ Determining gaps often requires meeting with people who have intimate knowledge of the system, as performance data is not always collected or readily available

Identify Alternatives



Description

- ▶ A survey of industry offerings available to fill holes identified in the gap analysis and an initial filtering of those offerings to determine a set of viable alternatives

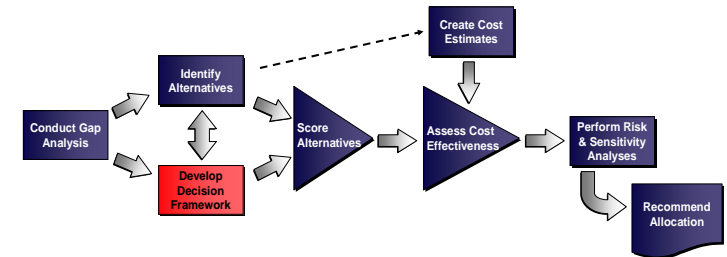
Activities



Considerations

- ▶ The market survey needs to be as all-encompassing as possible to attempt to identify any type of technology that might provide a needed capability.
- ▶ Filtering is a technique to eliminate alternatives that are non-viable. It is not the point at which the decision of which technology to choose is made.

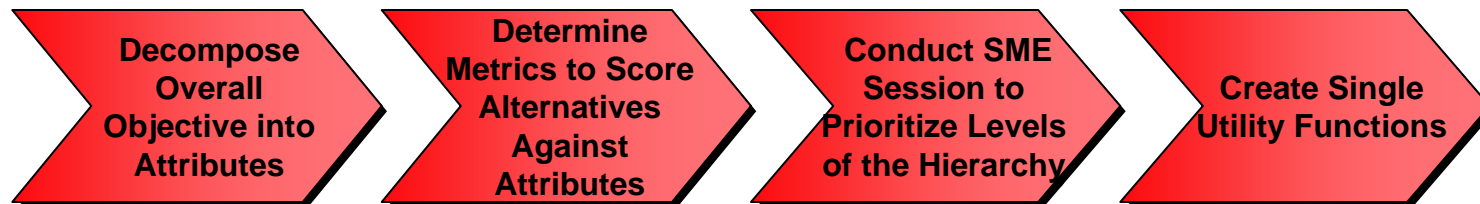
Develop Decision Framework



Description

- ▶ The creation of a value hierarchy, metrics, and hierarchy weights to assess the degree to which each alternative provides a needed capability

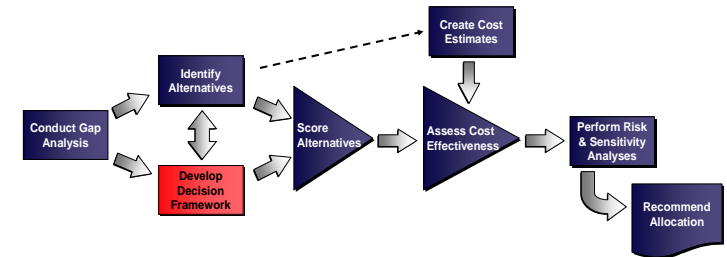
Activities



Considerations

- ▶ Constructing the hierarchy with visibility to both the gaps and the capabilities offered by the technologies (a “middle of the road” approach) produces a sound hierarchy
- ▶ Focus on system-wide capabilities, not technology-specific attributes

Develop Decision Framework



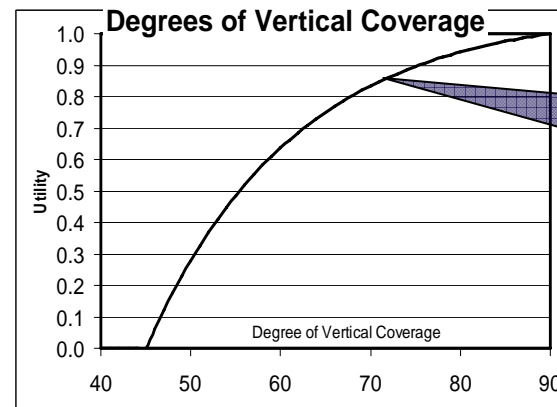
Considerations (cont'd)

- ▶ Measure effectiveness over performance when possible to better allow comparisons across all types of technologies
- ▶ Building SUFs needs input from the alternatives identification process to appropriately scope the trade space for each metric
- ▶ Several weightings of the hierarchy may need to occur to capture changes in preference for different missions, scenarios, tasks, etc.

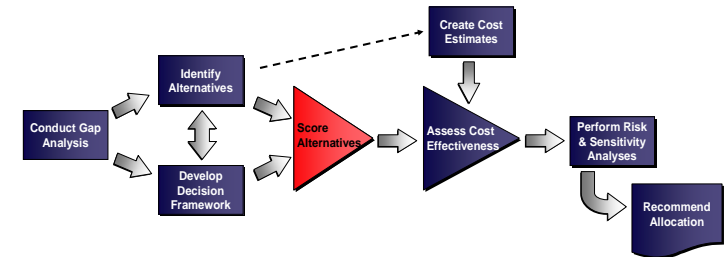
Sample Single Utility Function

Description: The amount of vertical visual coverage with a 90-degree maximum elevation and an appropriate depression (in addition to having 360 degrees panorama).

Units: degrees



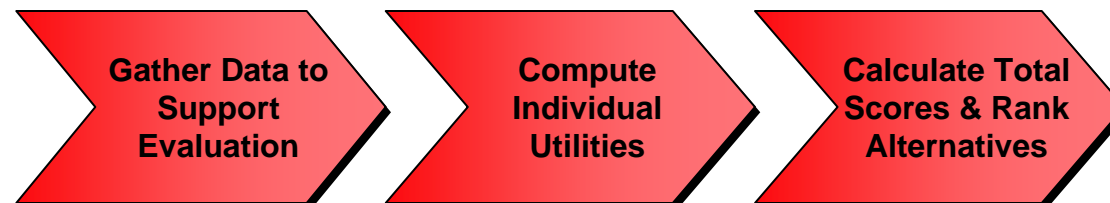
Score Alternatives



Description

- ▶ The assignment of an overall utility score to each alternative through individual single utility functions (SUFs) and the weighted hierarchy.

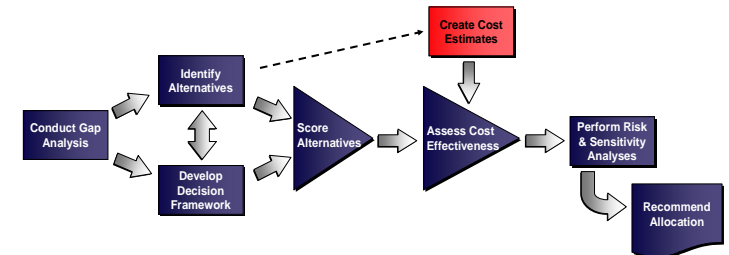
Activities



Considerations

- ▶ Use careful consideration when computing expected utilities when performance is uncertain
- ▶ Some alternatives when paired together may have a collective utility greater than the simple sum of their individual utilities. Ensure it is documented.

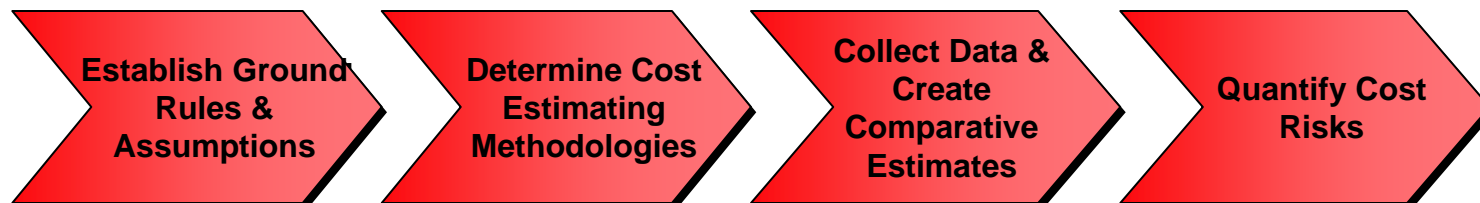
Cost Analysis



Description

- ▶ An estimate of the resources required to acquire, operate, and support each of the proposed alternatives across their system life cycles

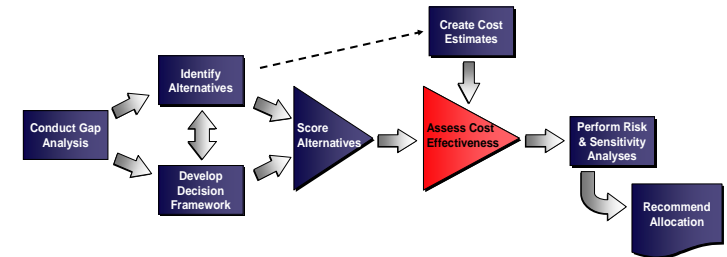
Activities



Considerations

- ▶ Focus on estimating elements of differentiation to get meaningful trades. A full life cycle cost estimate of the system is often not needed.
- ▶ As with any cost estimate, data collection is often challenging, so starting the cost estimate early in the study is highly recommended.

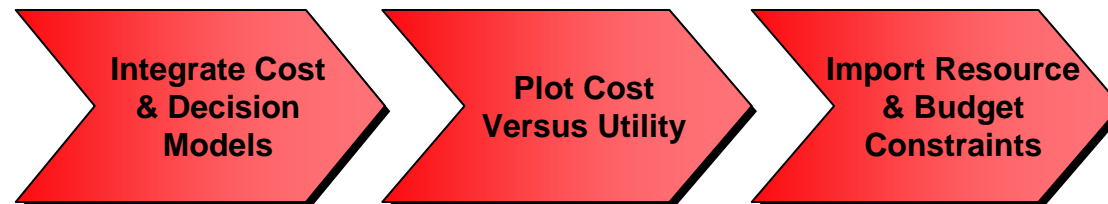
Assess Cost Effectiveness



Description

- ▶ A comparison of the cost per amount of utility gained across the domain of alternatives, highlighting the most efficient use of resources at each level of cost

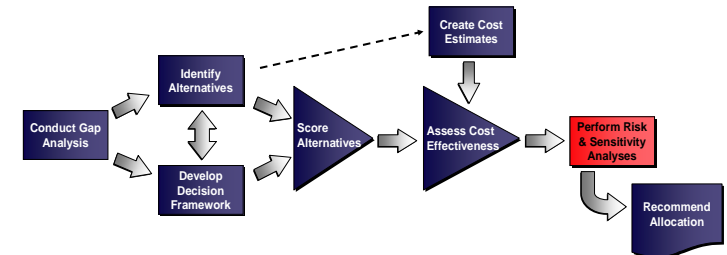
Activities



Considerations

- ▶ Any high-utility/low-cost outliers might need to be filtered out (and likely automatically recommended) before creating the Line of Efficient Frontiers (LOEF).
- ▶ Alternatives near the LOEF might move in/out of the efficient set due to risks, programmatic factors, etc., not specifically highlighted on the cost-utility plot.

Perform Sensitivity & Risk Analyses



Description

- ▶ An assessment of the 'stability' of the set of preferred alternatives with respect to 1) weights on the levels of the hierarchy and 2) uncertainties in the alternatives that might generate undesirable consequences

Activities



Considerations

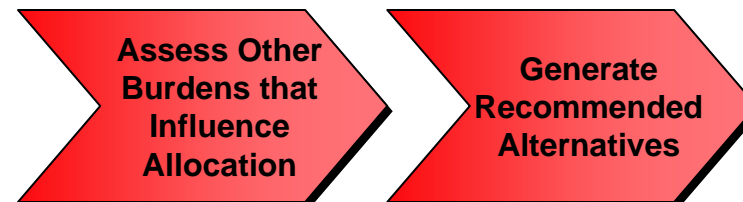
- ▶ When the overall ranking changes greatly with small changes in weights on attributes of the hierarchy, consider reexamining the hierarchy weighting.
- ▶ Risk assessment is challenging and varies study by study, client by client, and alternative by alternative. Remember, risk in the eye of the beholder.

Recommend Allocation

Description

- ▶ Given constraints, an endorsement of a technology (or set of technologies) that provides the most cost-effective use of resources towards filling the capability gaps.

Activities



Considerations

- ▶ Other factors in the decision environment might need to be tied into the analysis to further filter out alternatives on or near the efficient set.

Summary

The Trade Study Methodology summarized in this brief...

- ▶ ...bundles several sets of activities into a methodology that is well-suited for identifying cost-effective technology insertion solutions for an existing system
- ▶ ...consists of parallel and serial activities that converge to develop a defensible set of recommendations
- ▶ ...provides program managers with an analytically well-founded means for prioritizing investment decisions to deploy mission-essential capabilities to system customers

Questions?