Using Decision Analysis to Select Communications Research Projects

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Agenda

- Problem background
- Part 1: Hard Skills - Building the portfolio model
  - Selecting the best method
  - Building the model
- Part 2: Soft Skills - Selling the model to stakeholders and inspectors
  - Creation of a paper
  - Passing the inspection
- Reaction
- Summary

Problem Background

- An element of the Department Of Defense (DoD) needs to determine how to best allocate their limited research and development dollars with:
  - Multiple competing objectives
  - Multiple stakeholders
  - No tie-in with organization goals and objectives
  - No audit trail to track how decisions were made
- The customer approached the Decision and Risk Analysis Team to help them develop a better process

Old Method

- High-level deliberation and negotiation approach, or a "voting and bartering" method
- Benefit:
  - Stakeholders get a say in the process and can negotiate better positions for their favorite programs
- Issues:
  - Not traceable – there is no way of explaining and justifying a voting choice
  - Not fair – Voting groups can form and out-vote other organizations
  - Not tied to strategic goals
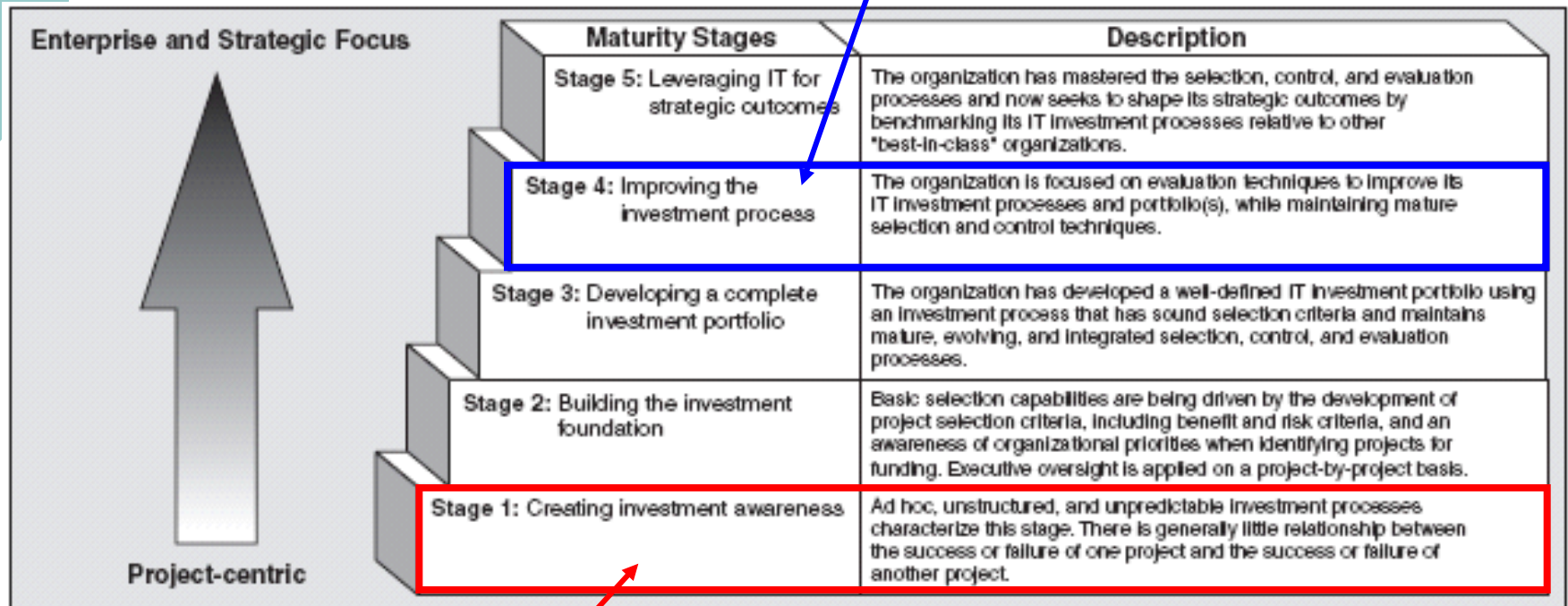 - Not repeatable
  - Not defendable

Part 1 – Building the Model

The Hard Skills

Our goal was to improve their process

We hoped to get them to maturity Stage 4

Enterprise and Strategic Focus	Maturity Stages	Description
	Stage 5: Leveraging IT for strategic outcomes	The organization has mastered the selection, control, and evaluation processes and now seeks to shape its strategic outcomes by benchmarking its IT investment processes relative to other "best-in-class" organizations.
	Stage 4: Improving the investment process	The organization is focused on evaluation techniques to improve its IT investment processes and portfolio(s), while maintaining mature selection and control techniques.
	Stage 3: Developing a complete investment portfolio	The organization has developed a well-defined IT investment portfolio using an investment process that has sound selection criteria and maintains mature, evolving, and integrated selection, control, and evaluation processes.
	Stage 2: Building the investment foundation	Basic selection capabilities are being driven by the development of project selection criteria, including benefit and risk criteria, and an awareness of organizational priorities when identifying projects for funding. Executive oversight is applied on a project-by-project basis.
Project-centric	**Stage 1: Creating investment awareness**	Ad hoc, unstructured, and unpredictable investment processes characterize this stage. There is generally little relationship between the success or failure of one project and the success or failure of another project.

Source: GAO.

The customer was at maturity Stage 1

[1] United States General Accounting Office. *GAO-04-394G. Information Technology Investment Management: A Framework for Assessing and Improving Process Maturity*. United States General Accounting Office. March 2004.

We needed to ensure that we picked the right approach

- Cost-benefit analysis is complex because:
  - Benefits are often intangible and hard to measure
  - There are uncertain outcomes and risk associated with research projects
  - There may be dependencies between projects
  - There are multiple stakeholders
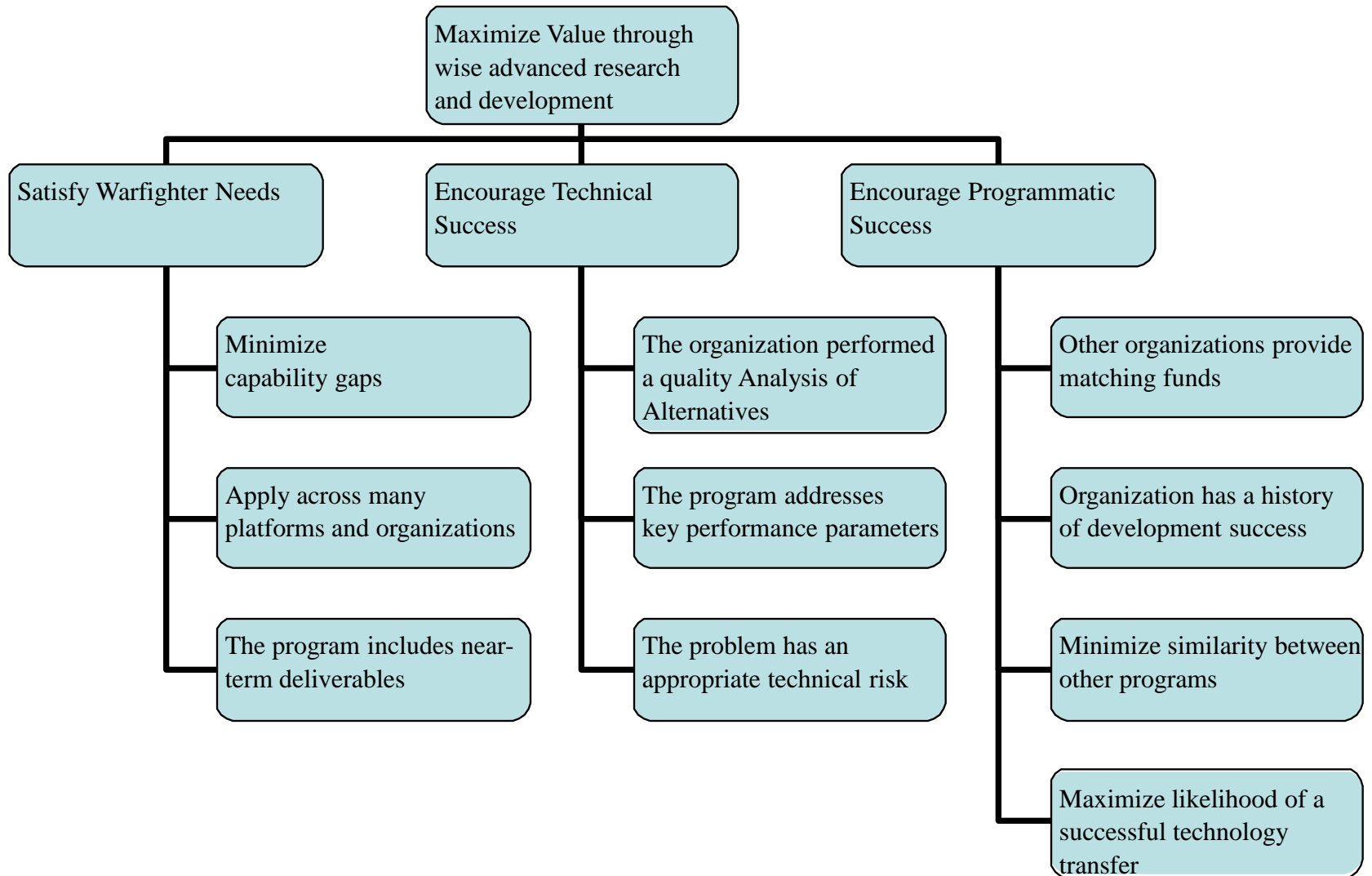 - There are conflicting objectives

We reviewed four possible approaches

- An accounting-focused approach
  - Identifies "bills" (alternatives requiring more funds) and "offsets" (sources for the funds to pay the bills)
  - Does not work for us because all projects are essentially bills
- A function-focused approach
  - Empowers subdivisions of an agency to develop a proposed program and budget in their assigned functional domain
  - Lacks a corporate view of programming objectives,
- A high-level deliberation and negotiation approach
  - Requires decision-makers to negotiate among themselves to develop a budget that meets organizational objectives.
  - While senior-level experience provides credibility to this approach it lacks defensible analytics to satisfy external auditors and critics
- A value-focused approach
  - Uses a model to quantify a program's value as the potential to fulfill programming guidance and achieve objectives
  - The value model is explicitly maps programmatic evaluation measures to programmatic guidance.

We selected a value-focused approach

- Of the four approaches described previously, only the value-focused approach satisfies customer information requirements.
- A value-focused approach:
  - Provides a consistent framework for stakeholders to use in assessing facts and making difficult trade-off decisions
  - Better aligns programming with agency and national strategic objectives
  - Provides transparency and traceability, which creates a more defensible budget
- We implemented the value-focused thinking approach using Multiple Objective Decision Analysis

Our value Hierarchy

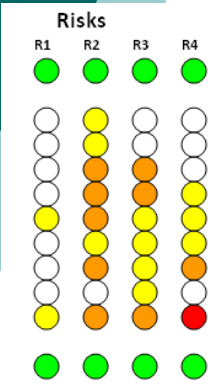# Minimize Capability Gap Value Measure*

		Innovation Level		
Done Toggle Values Update Relative		Thrust area is an enhancement of a current Service capability (TRL - 5)	Thrust area is a new use of a existing Service capability (TRL - 4)	Thrust area is known in the research community, but not currently used by the services (TRL - 3)
Capability Gap Satisfaction Level	Proposal satisfies one or more Capability Gaps (linked to a TRA) and is linked to an Actual Program	Proposal #3 70	Proposal #2 80	90
	Proposal satisfies one or more Capability Gap (No TRA, but identified via JCD/ICD)	30	Proposal #4 40	60
	Proposal satisfies no capability gaps, but is directly linked to distinct joint service requirements	0	5	Proposal #4 10

*Notional Data   11
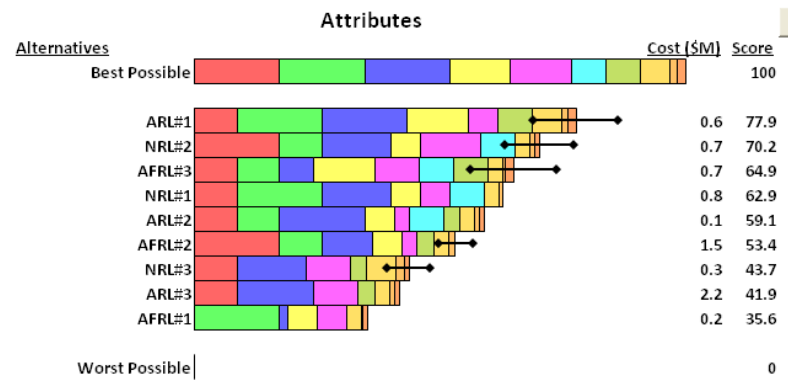
We used the Swing Weight Matrix*

	Intrinsic Importance to DoD			
Show Weights / **Toggle Values**	**NICE TO HAVE:** May Enhance the System Functions	**IMPORTANT:** Supports System Functions	**VERY IMPORTANT:** Improves the Quality of the System Functions	**CRITICAL:** Must have this to meet the Customer's Mission
High - There are significant differences between the programs	TransCommit AoA 100	KPPs 400	Jointness TechFeas 700	CapabilityGap 1000
Medium - The are noticable differences between the programs	50	MatchFunds 150	350	TimeImp 500
Low - The differences between the programs are not significant	PastPerf 1	50	Similar 75	100
NOT USED	0	0	0	0

Variability within the Portfolio (vertical axis label)

*Notional Weighting 12

Notional Results

Part 2 – Selling the Model

The Soft Skills

Pleasing the stakeholders

- Although our primary customer had compete buy-in on the process and the tool, they still needed the buy-in of two stakeholder groups
- The laboratories who submit proposals needed to be convinced that this technique was needed and that it was consistent with best practices
- The customer's oversight body knew that the current (the old) process was inadequate and scheduled an inspection that could have led to loss of decision authority if the inspection went poorly

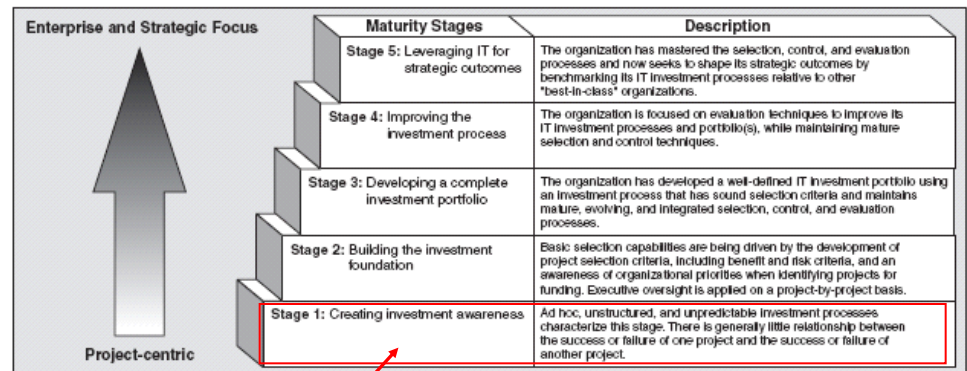# Justifying the approach to the Labs

- To justify the change to the labs we created a paper that showed why we picked our method and that this was consistent with other technical portfolio analysis techniques
- The paper included these sections
  - Why do a cost-benefit analysis?
  - How should you conduct a cost-benefit analysis?
  - But will this work for the DoD?
  - But will this work for NSA?

Why do a cost-benefit analysis?

○ Executive level guidance states that organizations should strive to spend taxpayer dollars more effectively each year. Cost-benefit analysis is a common DoD analysis technique

○ The President says so…

○ Other Government agencies say so…

- OMB
- GAO
- RAND

This graphic was very compelling

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How should you conduct a cost-benefit analysis?

- For complex decisions that involve:
  - Conditions of uncertainty
  - Multiple stakeholders
  - Conflicting objectives
- Use the commonly accepted techniques:
  - Value focused thinking
  - Multiple-objective decision analysis
- Ensure that the selected technique:
  - Provides a consistent framework for stakeholders to use in assessing facts and making difficult trade-off decisions
  - Better aligns programming with agency and national strategic objectives
  - Provides transparency and traceability, which creates a more defensible budget

But will it work for DoD?

○ Yes – we identified the following DoD projects that successfully used cost-benefit analysis for investment portfolio decision-making

- Army 2005 BRAC study[1]
- Marine Corps Annual Budget Process[2]
- Air Force Research Laboratory Space Technology Value Model[3]

[1] (U) Ewing, Paul L. Jr., Tarantino, William and Parnell, Gregory S. *Use of Decision Analysis in the Army Base Realignment and Closure (BRAC) 2005 Military Value Analysis*. Volume 3, Number 1. *Decision Analysis*. March 2006.
[2] (U) Buede, Dennis and Peterson, Cameron. *An Application of Cost-Benefit Analysis to the USMC Program Objective Memorandum (POM)*. Nov 1977.
[3] (U) Leitch, Scott, Kuskey, Ken, Buede, Dennis, and Bresnick, Terry. "Of Princes, Frogs, and Marine Corps' Budgets: Institutionalizing Decision Analysis over 23 Years." Decision Analysis Practice Award Presentation. *Institute for Operations Research Management and Science*. Annual Conference. November 1999.

But will it work for NSA?

- Yes - we identified numerous NSA organizations that successfully use cost-benefit analysis for investment portfolio decision-making for a variety of purposes including:
  - Identifying strategies for correcting capability gaps at the agency and directorate level
  - Picking the best research portfolio programs
  - Picking the best mitigation strategy for cyber risk
  - Picking the best portfolio of sites to grow additional missions
  - Picking the best portfolio of upgrade decisions for key facilities

Reaction

- Hard Skills – Building the Model
  - The customer loved the process and the tool and was able to sustain the model without our help
  - They believe the value of their selected portfolios are significantly better
  - They believe the model helps create better programs to be evaluated

- Soft Skills – Selling the model
  - Laboratories feelings are mixed
    - Those with better processes like it
    - Those who were good at "bartering" do not like it
    - No one could argue with the method
  - The paper was finished as the customer was being audited on their processes
    - The method and paper helped them to pass their inspection
    - They retained their decision authority

Summary

- Our customer wanted to improve the value of their research portfolio by finding a better process
- We implemented a value-focused thinking approach using multiple objective decision analysis
- We created the documentation needed to get support for the change from stakeholders and auditors
- The customer believes the approach helps pick a more valuable portfolio and ultimately creates better alternatives