46th Annual Gun and Missile Systems Conference

Considerations for Performing a Portfolio Analysis

Jim Rodrigue
Jon Peoble
April 12, 2011
Agenda

- Conducting a Portfolio Analysis
  - What are they
  - Goal Programming Models

- Sample Portfolio Analysis
  - Scenario and Munition Mix
  - Results

- Conclusions
Portfolio Analyses

- Supports SecDef and VCSA memorandums on efficiency, cost-benefit analysis, and buying power
  - Identify redundancies and gaps in portfolios of munitions, force-structure, and/or equipment
  - Cost-benefit analysis from a portfolio viewpoint
  - Develop efficiencies and eliminate non-essential programs

- Comprehensive portfolio analysis includes both goal-programming and force-on-force modeling with approved scenarios
  - Cost, Performance, and Relevance
  - Cost Benefit Analysis, Analysis of Alternatives, Military Utility Analysis, CONOPS
Goal Programming Model Overview

- Allows for quick-turn Analysis of Alternatives and Cost Benefit Analysis
  - Model analyzes alternatives based on a set of weighted goals and constraints
    - Cost, lethality, SME preference, collateral damage, logistics, etc.
  - Scenario definitions are flexible and easily modified to represent different conditions
    - Eliminate as many targets as possible while adhering to defined goals and constraints

- Benefits of GP Model
  - Quick turn-around for fast reaction to events
  - Ability to analyze large case matrices and munition mix variants

- Limitations of GP Model
  - Not able to quantify benefits to Warfighter effectiveness and survivability
  - Output is only valid if chosen scenario and goals reflect real-world situations and intent

Goal-Programming results in different “optimal” solutions based on the user-defined goals and constraints
Major Considerations for an Analysis

- **Munition Mix:**
  - Entire portfolio must be represented

- **Scenario(s):**
  - Scenario determines supply of munitions, range to targets, and the target set
  - Need to choose a scenario with a target set that fully exercises the entire set of munitions in the mix

- **Goals and Constraints:**
  - Importance (i.e. weight) given to each goal can have large consequences on final outcome of the analysis
  - Need to ensure that model inputs reflect real-world priorities and intent
    - What is the most important goal?
    - Cost? Reduction of Collateral Damage? Logistics? Other?
  - Need to ensure that all critical considerations are represented by goals

**Inputs into Goal Programming model must reflect real-world intent for Portfolio Analysis to be instructive**
Scenario Description

- Based on customer-defined OEF Vignette

- Blue Forces:
  - IBCT(-) establishes and maintains Operating Areas to limit enemy’s ability to influence Friendly operations and set condition for long term stability
  - Collateral Damage must be minimized in urban areas
  - Fires Support:
    - Division General Support: 8 155mm Paladins, 4 227mm M270
    - IBCT Motorized RSTA Squadron: 4 120mm M120
    - Joint Air
  - All categories of precision and conventional indirect fires included in munition mix

- Threat Forces:
  - Insurgent cells located along mountainsides and urban areas
  - Mix of IEDs, mortars, small-arms fires, RPGs, and trucks
  - Threat uses protective features when possible (walls, rocks)
  - Totals:
    - 9 Personnel Target Types, 4 Physical Target Types
    - 84 Distinct Mission Demands; 396 Total Mission Demands

Irregular Warfare scenario presents IBCT with a wide variety of targets and missions
GP Model Settings

- Minimize Munition Cost is the only goal
- 100% Mission Effectiveness enforced

Chart shows the number of missions completed by each munition

- Color-coding details the type of target eliminated during that mission

Results

- If Cost is the only goal, large mix of munitions are chosen to complete the various missions
- Near-Precision munition widely used due to being less costly than precision/joint munitions and having increased performance over area munitions
- Precision artillery and joint munitions only used to destroy structure targets due to having higher munition cost

If cost is the only goal being considered, portfolio consists of a mix of conventional, near-precision and precision

*Intermediate results; not final analysis
New Goal Consideration: Logistics*

- **GP Model Settings**
  - Cost weighted at 100% importance
  - Logistic Goal being considered
  - 100% Mission Effectiveness

- Upper chart shows composition of portfolio as logistics goal is considered

- Reducing logistics can drastically reduce overall cost so we considered Logistics to be ½ as important as munition cost

- Weighting Logistics to be ½ as important as munition costs results in a shift from conventional munitions to more efficient and effective precision munitions

When Logistics is considered with Munition Cost, portfolio begins to shifts more towards more efficient and effective precision munitions

*Intermediate results; not final analysis

9/22/2011
New Goal Consideration: Collateral Damage (CD)*

- GP Model Settings
  - Cost weighted at 100% importance
  - Logistics weighted at 50% of Cost
  - CD Goal being considered
  - 100% Mission Effectiveness

- Upper chart shows composition of portfolio as CD goal is considered
- Reducing CD is critically important to today’s missions so we considered CD to be equally important as munition cost
- Adding CD to the GP Model results in a considerable shift towards precision munitions, especially for Urban targets

Adjusting the GP model to more closely represent the goals of real-world missions results in a considerably different munition mix with large shift to precision

Approved for public release TPCR RMS-1435

*Intermediate results; not final analysis
Conclusions

- Analysis shows the importance/weight assigned to goals can greatly effect the portfolio
- Careful consideration must be given to ensure output of model matches mission intent
  - Must ensure that all important goals are represented in the model
  - Must ensure that weighting of goals reflects real-world intent
  - Must ensure that scenario has a target set that exercises the entire portfolio under consideration
- Sample analysis only shows Goal-Programming model results. A full portfolio analysis should combine these with a force-on-force simulation
  - Force-on-force simulation provides the military utility of the portfolio; defines the Warfighter Benefit

When conducting a portfolio analysis, careful considerations must be given to the goals represented in the GP model to ensure that they reflect real-world intent
Questions?

Jim Rodrigue
Raytheon Missile Systems
520.794.1349
jmrodrigue@raytheon.com

Jon Peoble
Raytheon Missile Systems
520.545.7841
Jon.Peoble@raytheon.com