

Using the Anti-Surface Warfare Salvo Model

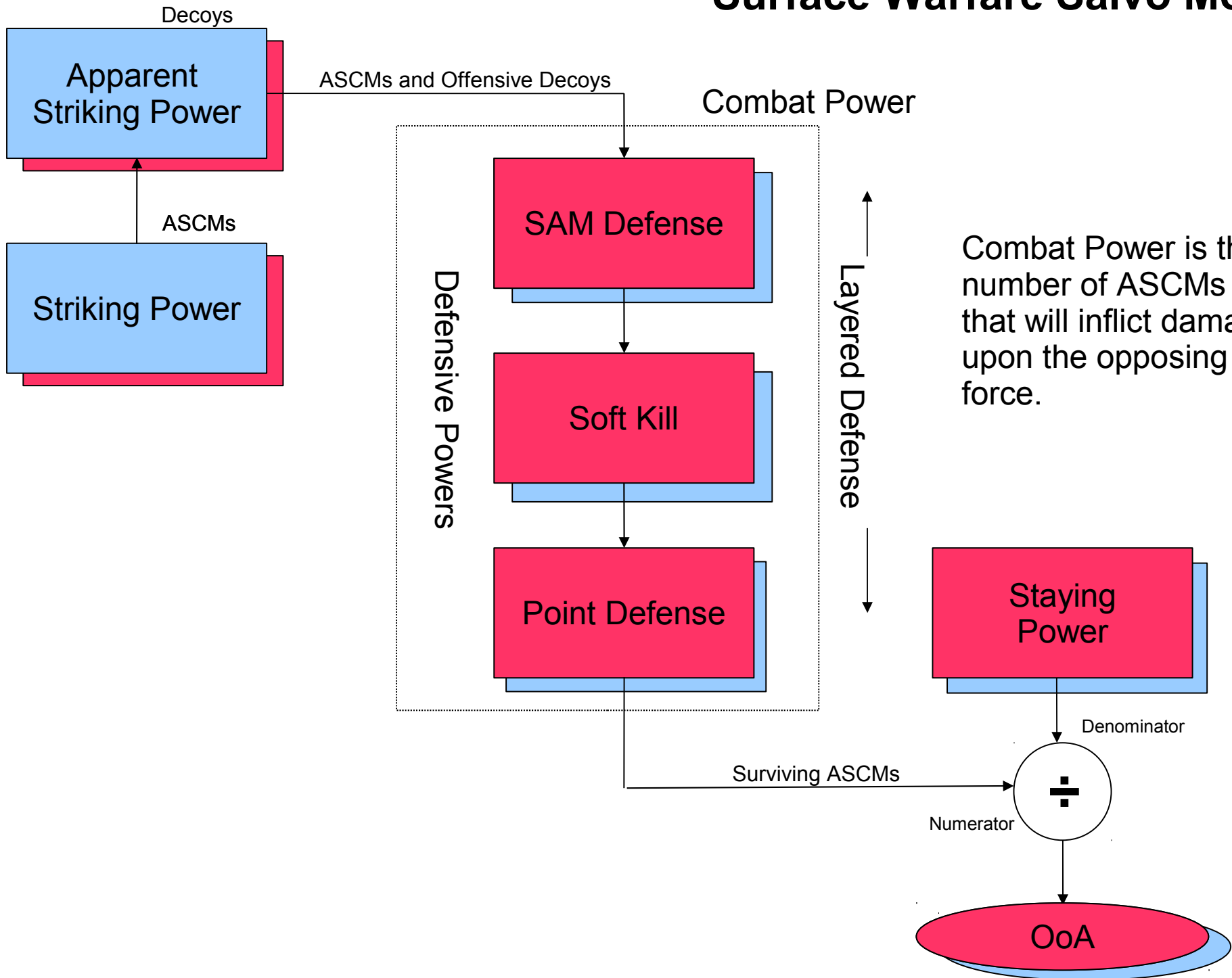
to look for

Low Hanging Fruit

An Application of Monte-Carlo Analysis



Surface Warfare Salvo Model



NDIA Salvo Model Data (spreadsheet model version)

Input Data

*SMlite.gnumeric : Gnumeric

File Edit View Insert Format Tools Data Help

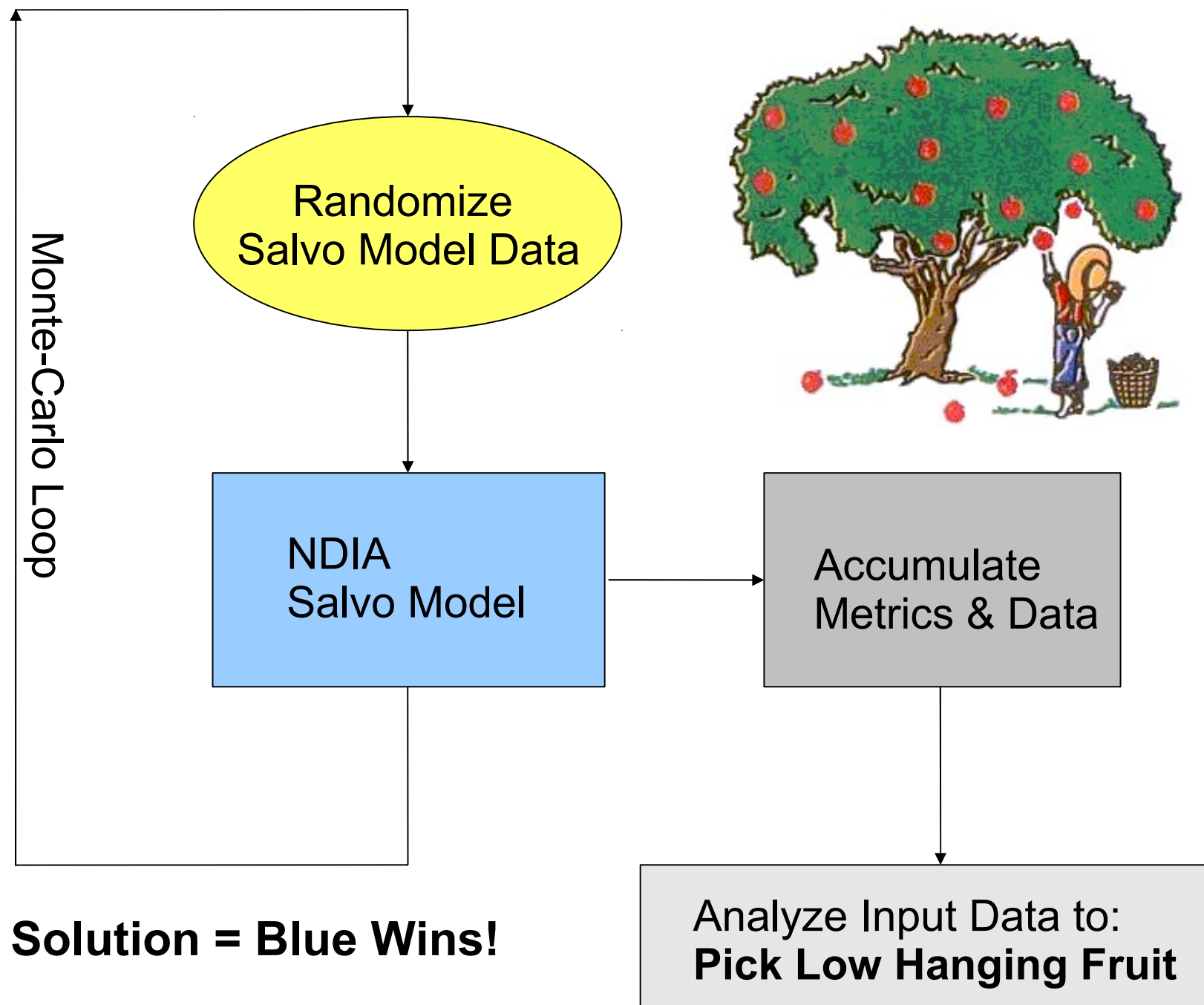
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| NDIA SAG v SAG Salvo Model (January 26, 2010) | | | | |
|---|---------|---------|--------|--------|
| SAG | Units | Blue | Red | |
| Number of ships | # | 3 | 6 | |
| Force scouting effectiveness | 0 - 1 | 0.8 | 0.7 | |
| Ship vulnerability | # ASCMs | 0.8 | 1.4 | |
| ASCM Engagement | | | | |
| ASCM salvo size per ship | # | 5.3 | 6.8 | |
| ASCM launch reliability | 0 - 1 | 0.74 | 0.94 | |
| ASCM effectiveness | 0 - 1 | 0.84 | 0.62 | |
| Offensive decoy salvo size per ship | # | 4 | 0 | |
| SAM Defense | | | | |
| SAM defense readiness | 0 - 1 | 0.87 | 0.66 | |
| SAM FC channels per ship | # | 3 | 3.9 | |
| SAM effectiveness | 0 - 1 | 0.79 | 0.6 | |
| Soft Kill Defense | | | | |
| Soft kill readiness | 0 - 1 | 0.85 | 0.65 | |
| Soft kill salvo size per ship | # | 2 | 1.6 | |
| Point Defense | | | | |
| Point defense readiness | 0 - 1 | 0.82 | 0.8 | |
| Point defense FC channels per ship | # | 2 | 5 | |
| Point defense effectiveness | # | 0.7 | 0.6 | |
| Salvo Exchange MOEs | | Units | Blue | Red |
| Number of ships OoA | | # | 1.45 | 0.44 |
| Fraction of force OoA | | 0 - 1 | 0.48 | 0.07 |
| Force exchange ratio | | +/- | 6.56 | 0.15 |
| Force Level MOPs | | Units | Blue | Red |
| Striking power | | # ASCMs | 7.91 | 16.64 |
| Apparent striking power | | # ASCMs | 13.87 | 16.64 |
| SAM defensive capacity | | # ASCMs | 7.83 | 15.44 |
| SAM defense posture | | | Weak | Strong |
| Combat Power (SAM defense) | | # ASCMs | 3.16 | 10.46 |
| Decoy dilution | | 0 - 1 | 0.37 | 0.49 |
| Combat Power (Soft kill) | | # ASCMs | 1.55 | 3.87 |
| Point defense capacity | | # ASCMs | 4.92 | 24.00 |
| Point defense posture | | | Strong | Strong |
| Combat Power (Point defense) | | # ASCMs | 0.62 | 1.16 |

Model | Input Data Defns | Output Data Defns

Sum=0

Method to Determine First-Order Solution Space



Scenarios

Scenario 1 Short Range Exchange

Both forces are within their ASCM ranges

Simultaneous Salvo exchange using *nominal* parameters

Scenario 2 Long Range Defense, Short Range Exchange

Red fires first at long range with YJ-62s and SS-NX-22Bs with *degraded* parameters

Blue defends

Surviving Blue Force closes to Harpoon Range

Simultaneous Salvo exchange using *nominal* parameters with remaining assets

Scenario 1a Short Range Exchange with Optimal Technology

Both forces are within their ASCM ranges

Simultaneous Salvo exchange using Blue "*Optimized Technology*" parameters

Scenario 2a Long Range Defense, Short Range Exchange with Optimal Technology

Red fires first at long range with YJ-62s and SS-NX-22Bs with *degraded* parameters

Blue defends using "*Optimized Technology*" parameters

Surviving Blue Force closes to Harpoon Range

Simultaneous Salvo exchange using Blue "*Optimized Technology*" parameters with

remaining assets

MOE: Number of Blue Ships > Number of Red Ships = Blue Wins!

Scenario 1 with *Nominal* Parameters

Both Forces within their ASCM range

Simultaneous Exchange

| Scenario 1 - Short Range Exchange | | | |
|-------------------------------------|---------|-------------|------------|
| SAG | Units | Blue | Red |
| Number of ships | # | 3 | 6 |
| Force scouting effectiveness | 0 - 1 | 0.65 - 0.98 | 0.5 - 0.9 |
| Ship vulnerability | # ASCMs | 0.8 - 2.0 | 0.5 - 1.5 |
| ASCM Engagement | | | |
| ASCM salvo size per ship | # | 5.3 | 5.3 - 10.7 |
| ASCM launch reliability | 0 - 1 | 0.7 - 0.98 | 0.6 - 0.92 |
| ASCM effectiveness | 0 - 1 | 0.5 - 0.9 | 0.5 - 0.85 |
| Offensive decoy salvo size per ship | # | 1 - 6 | 0 |
| SAM Defense | | | |
| SAM defense readiness | 0 - 1 | 0.7 - 0.98 | 0.5 - 0.9 |
| SAM FC channels per ship | # | 3 - 5 | 2 - 4 |
| SAM effectiveness | 0 - 1 | 0.5 - 0.85 | 0.5 - 0.75 |
| Soft Kill Defense | | | |
| Soft kill readiness | 0 - 1 | 0.7 - 0.98 | 0.5 - 0.9 |
| Soft kill salvo size per ship | # | 1 - 4 | 1 - 4 |
| Point Defense | | | |
| Point defense readiness | 0 - 1 | 0.7 - 0.98 | 0.5 - 0.9 |
| Point defense FC channels per ship | # | 1 - 4 | 1 - 6 |
| Point defense effectiveness | # | 0.5 - 0.85 | 0.5 - 0.75 |

Match-Up

Better Scouting

Stronger Ships

Less Missiles

Offensive Decoys

Better SAMS

More Channels

Equal Softkill

Better CIWS

Less Channels

Results:

10,000 Replications

Blue wins (More Surviving Ships) < 0.01% of exchanges

Scenario 2 with *Nominal* Parameters

Red Fires at Long Range – Blue Defends

Survivors Close to Shorter Range Exchange

Match-Up

| Scenario 2 - Long Range Defense | | | |
|-------------------------------------|---------|------------|------------|
| SAG | Units | Blue | Red |
| Number of ships | # | 3 | 6 |
| Force scouting effectiveness | 0 - 1 | | 0.35 - 0.6 |
| Ship vulnerability | # ASCMs | 0.8 - 2.0 | 0.5 - 1.5 |
| ASCM Engagement | | | |
| ASCM salvo size per ship | # | | 2 - 4 |
| ASCM launch reliability | 0 - 1 | | 0.6 - 0.92 |
| ASCM effectiveness | 0 - 1 | | 0.4 - 0.65 |
| Offensive decoy salvo size per ship | # | | 0 |
| SAM Defense | | | |
| SAM defense readiness | 0 - 1 | 0.7 - 0.98 | 0.5 - 0.9 |
| SAM FC channels per ship | # | 3 - 5 | 2 - 4 |
| SAM effectiveness | 0 - 1 | 0.5 - 0.85 | 0.5 - 0.75 |
| Soft Kill Defense | | | |
| Soft kill readiness | 0 - 1 | 0.7 - 0.98 | 0.5 - 0.9 |
| Soft kill salvo size per ship | # | 1 - 4 | 1 - 4 |
| Point Defense | | | |
| Point defense readiness | 0 - 1 | 0.7 - 0.98 | 0.5 - 0.9 |
| Point defense FC channels per ship | # | 1 - 4 | 1 - 6 |
| Point defense effectiveness | # | 0.5 - 0.85 | 0.5 - 0.75 |

| Short Range Exchange | |
|----------------------|------------|
| Blue | Red |
| | 6 |
| 0.65 - 0.98 | 0.5 - 0.9 |
| 0.8 - 2.0 | 0.5 - 1.5 |
| 5.3 | 3.3 - 6.6 |
| 0.7 - 0.98 | 0.6 - 0.92 |
| 0.7 - 0.9 | 0.5 - 0.85 |
| 1 - 6 | 0 |
| 0.7 - 0.98 | 0.5 - 0.9 |
| 3 - 5 | 2 - 4 |
| 0.5 - 0.85 | 0.5 - 0.75 |
| 0.7 - 0.98 | 0.5 - 0.9 |
| 1 - 4 | 1 - 4 |
| 0.7 - 0.98 | 0.5 - 0.9 |
| 1 - 4 | 1 - 6 |
| 0.5 - 0.85 | 0.5 - 0.75 |

Results: 10,000 Replications
 Blue wins (More Surviving Ships) < 0.07% of exchanges

Scenario 1a with *Optimal Blue Technology Parameters*

Both Forces within their ASCM range

Simultaneous exchange

| Scenario 1 - Short Range Exchange | | | |
|-------------------------------------|---------|-----------|------------|
| SAG | Units | Blue | Red |
| Number of ships | # | 3 | 6 |
| Force scouting effectiveness | 0 - 1 | 0.98 | 0.5 |
| Ship vulnerability | # ASCMs | 0.8 - 2.0 | 0.5 - 1.5 |
| ASCM Engagement | | | |
| ASCM salvo size per ship | # | 5.3 | 5.3 - 10.7 |
| ASCM launch reliability | 0 - 1 | 0.98 | 0.6 - 0.92 |
| ASCM effectiveness | 0 - 1 | 0.9 | 0.5 - 0.85 |
| Offensive decoy salvo size per ship | # | 6 | 0 |
| SAM Defense | | | |
| SAM defense readiness | 0 - 1 | 0.98 | 0.5 - 0.9 |
| SAM FC channels per ship | # | 5 | 2 - 4 |
| SAM effectiveness | 0 - 1 | 0.85 | 0.5 |
| Soft Kill Defense | | | |
| Soft kill readiness | 0 - 1 | 0.98 | 0.5 |
| Soft kill salvo size per ship | # | 4 | 1 - 4 |
| Point Defense | | | |
| Point defense readiness | 0 - 1 | 0.98 | 0.5 - 0.9 |
| Point defense FC channels per ship | # | 4 | 1 - 6 |
| Point defense effectiveness | # | 0.85 | 0.5 |

Match-Up

- Better Scouting
- Stealthier Ships
- Better Missiles
- More Decoys
- Better SAMS
- Better Vulnerability
- Better Softkill
- Less Susceptible
- Better CIWS
- Better Vulnerability

Results:

10,000 Replications
Blue wins (More Surviving Ships) < 2.2% of exchanges

Scenario 2a with Optimal Blue Technology Parameters

Red Fires at Long Range – Blue Defends

Survivors Close to Shorter Range Exchange

Match-Up

| Scenario 2a - Long range Defense | | | |
|-------------------------------------|---------|-----------|------------|
| SAG | Units | Blue | Red |
| Number of ships | # | 3 | 6 |
| Force scouting effectiveness | 0 - 1 | | 0.35 |
| Ship vulnerability | # ASCMs | 0.8 - 2.0 | 0.5 - 1.5 |
| ASCM Engagement | | | |
| ASCM salvo size per ship | # | | 2 - 4 |
| ASCM launch reliability | 0 - 1 | | 0.6 - 0.92 |
| ASCM effectiveness | 0 - 1 | | 0.4 - 0.65 |
| Offensive decoy salvo size per ship | # | | 0 |
| SAM Defense | | | |
| SAM defense readiness | 0 - 1 | 0.98 | 0.5 - 0.9 |
| SAM FC channels per ship | # | 5 | 2 - 4 |
| SAM effectiveness | 0 - 1 | 0.85 | 0.5 |
| Soft Kill Defense | | | |
| Soft kill readiness | 0 - 1 | 0.98 | 0.5 |
| Soft kill salvo size per ship | # | 4 | 1 - 4 |
| Point Defense | | | |
| Point defense readiness | 0 - 1 | 0.98 | 0.5 - 0.9 |
| Point defense FC channels per ship | # | 4 | 1 - 6 |
| Point defense effectiveness | # | 0.85 | 0.5 |

| Short Range Exchange | |
|----------------------|------------|
| Blue | Red |
| | 6 |
| 0.98 | 0.5 |
| 0.8 - 2.0 | 0.5 - 1.5 |
| | |
| 5.3 | 3.3 - 6.7 |
| 0.98 | 0.6 - 0.92 |
| 0.9 | .5 - .85 |
| 6 | 0 |
| | |
| 0.98 | 0.5 - 0.9 |
| 5 | 2 - 4 |
| 0.85 | 0.5 |
| | |
| 0.98 | 0.5 |
| 4 | 1 - 4 |
| | |
| 0.98 | 0.5 - 0.9 |
| 4 | 1 - 6 |
| 0.85 | 0.5 |

Results: 10,000 Replications
 Blue wins (More Surviving Ships) < 32.8% of exchanges



Conclusion:

**We're going to need a Longer Ladder
(more ASCM assets)**

or

**a Shorter Tree!
(less stressing scenario)**



Technology is NOT always the answer!