



RDD Risk

A Quick 'n' Dirty Discussion

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Terrorism Risk

The expected consequence of an existent threat, which for a given target, attack mode, target vulnerability, and damage type can be expressed as:

$$\begin{aligned} \text{Terrorism Risk} &= \\ &P(\text{attack occurs}) \\ &\times P(\text{attack results in damage} \mid \text{attack occurs}) \\ &\times E[\text{damage} \mid \text{attack occurs \& results in damage}] \\ &= \text{Threat} \times \text{Vulnerability} \times \text{Consequence} \end{aligned}$$



Sun Tzu Wu

Early Second century B.C.

The Art of War, Chapter IV

“In ancient times skillful warriors first made themselves invincible, and then watched for vulnerability in their opponents ... Invincibility is a matter of defense, *vulnerability is a matter of attack.*”

Key steps: “ ... measurement, assessment, calculation, comparison, and victory.”

Source: *Art of War*, www.academic.bowdoin.edu/suntzu/overview.html,
accessed February 2004



Exercise

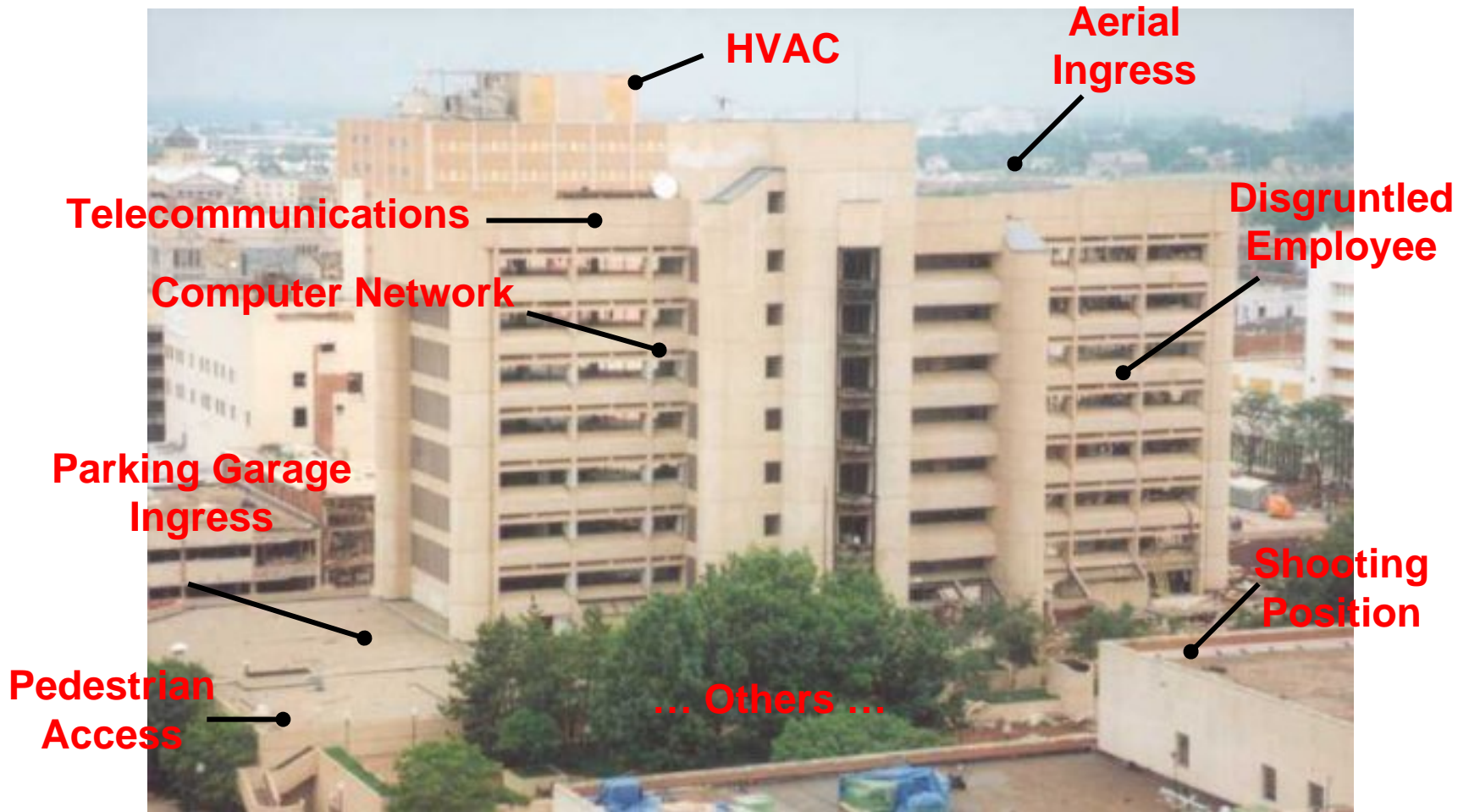
Where is the Vulnerability?





Solution

Information, Structural, Access, Behavioral, ...





“A retaliatory strike ...”

Timothy McVeigh, May 2001



April 19, 1995, Alfred P. Murrah Building, Oklahoma City;
CONSEQUENCE: 4800 lb ammonium nitrate fertilizer and nitromethane; 169
adults and 19 children killed



Common Terms

- Blue – good guys
- Red – bad guys
- One-sided
 - ✓ Blue on Red: defeat Red
 - ✓ Red on Blue: defeat Blue
- Two-sided – interaction

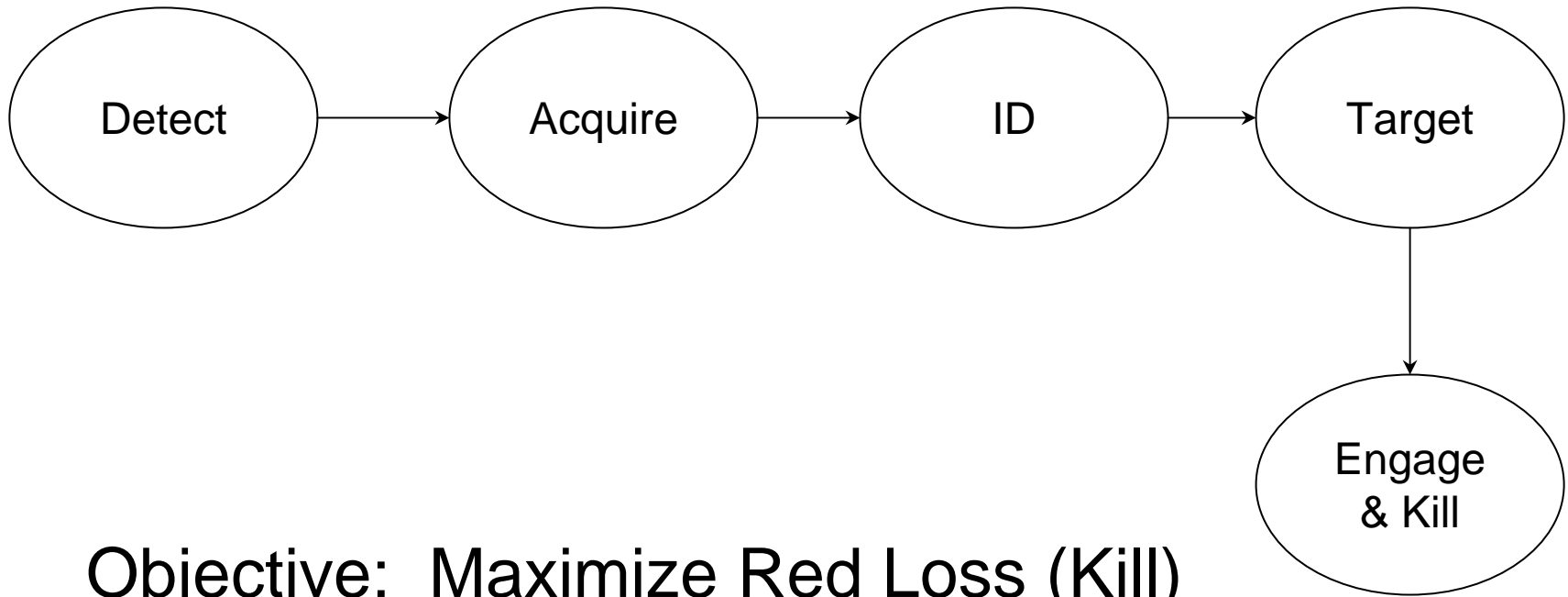


Uncertainty and Variability

- ***Model uncertainty*** – limited ability of math models to accurately represent the real world
- ***Parameter uncertainty (variability)*** – statistical variability in the estimation of model parameters due to measurement error and sampling error
- ***Decision-rule uncertainty*** – imprecise or inappropriate operational definitions for desired outcome criteria, value parameters, and decision variables.
- ***Deep uncertainty*** – complex functional and structural arrangements of variables
- ***Natural variability*** – life and inherently random factors



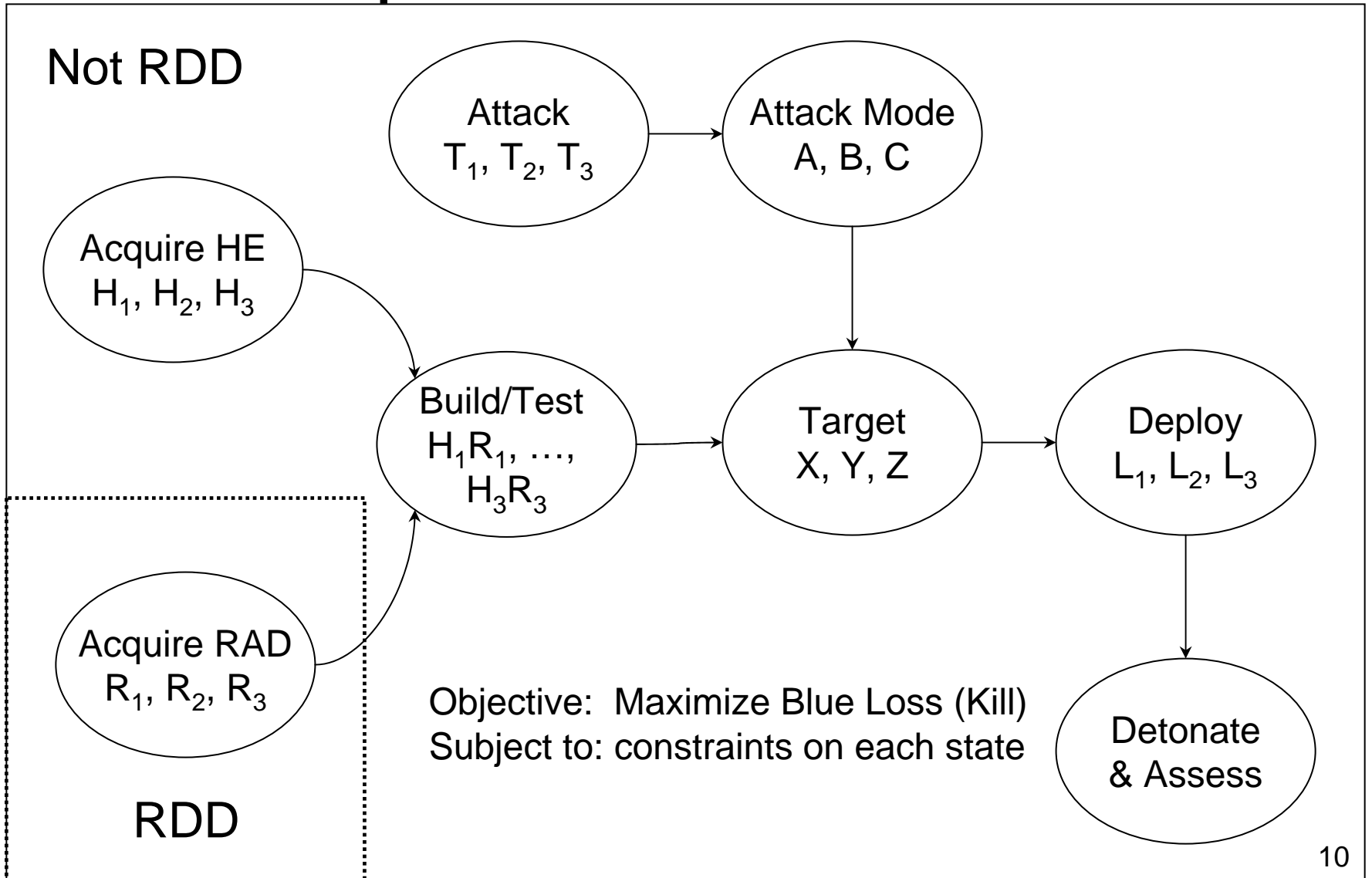
Simple Blue Tactical on Red



Objective: Maximize Red Loss (Kill)
Subject to: constraints on each state



Simple Red RDD on Blue





RDD Risk

RDD Risk =

$P(\text{attack occurs})$

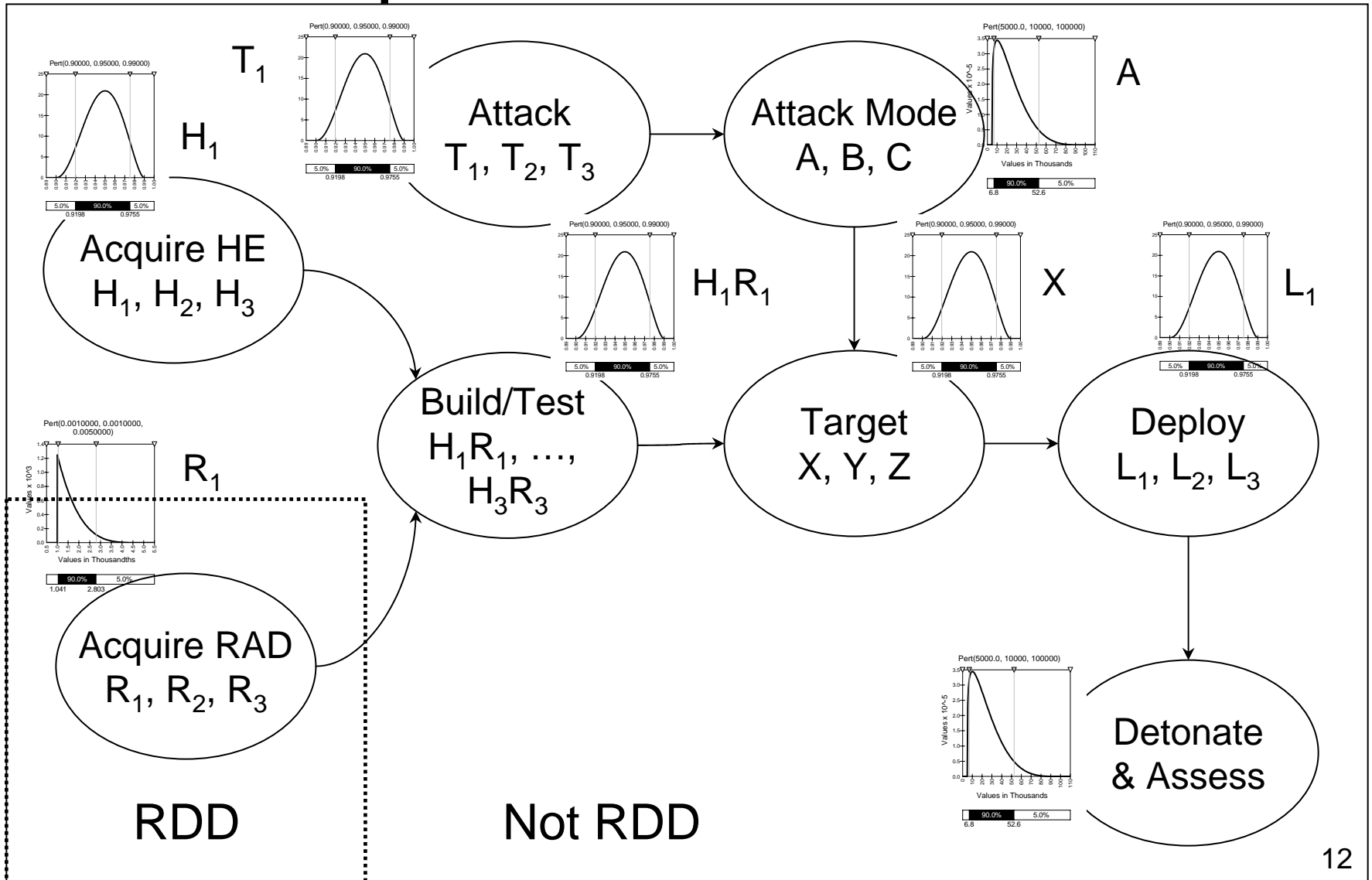
$\times P(\text{attack results in damage} \mid \text{attack occurs})$

$\times E[\text{damage} \mid \text{attack occurs} \ \& \ \text{results in damage}]$

= Threat \times Vulnerability \times Consequence

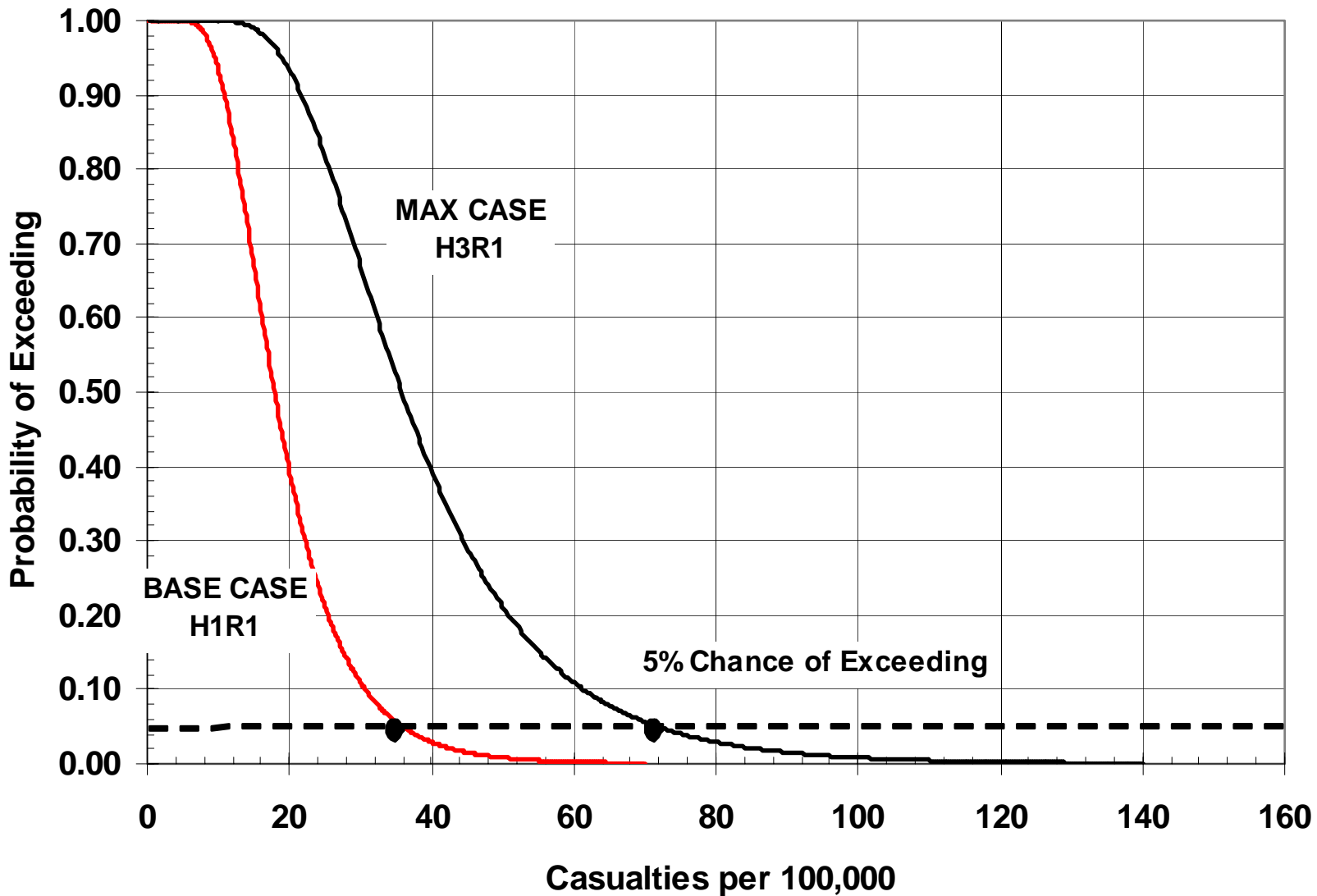


Simple Red RDD on Blue



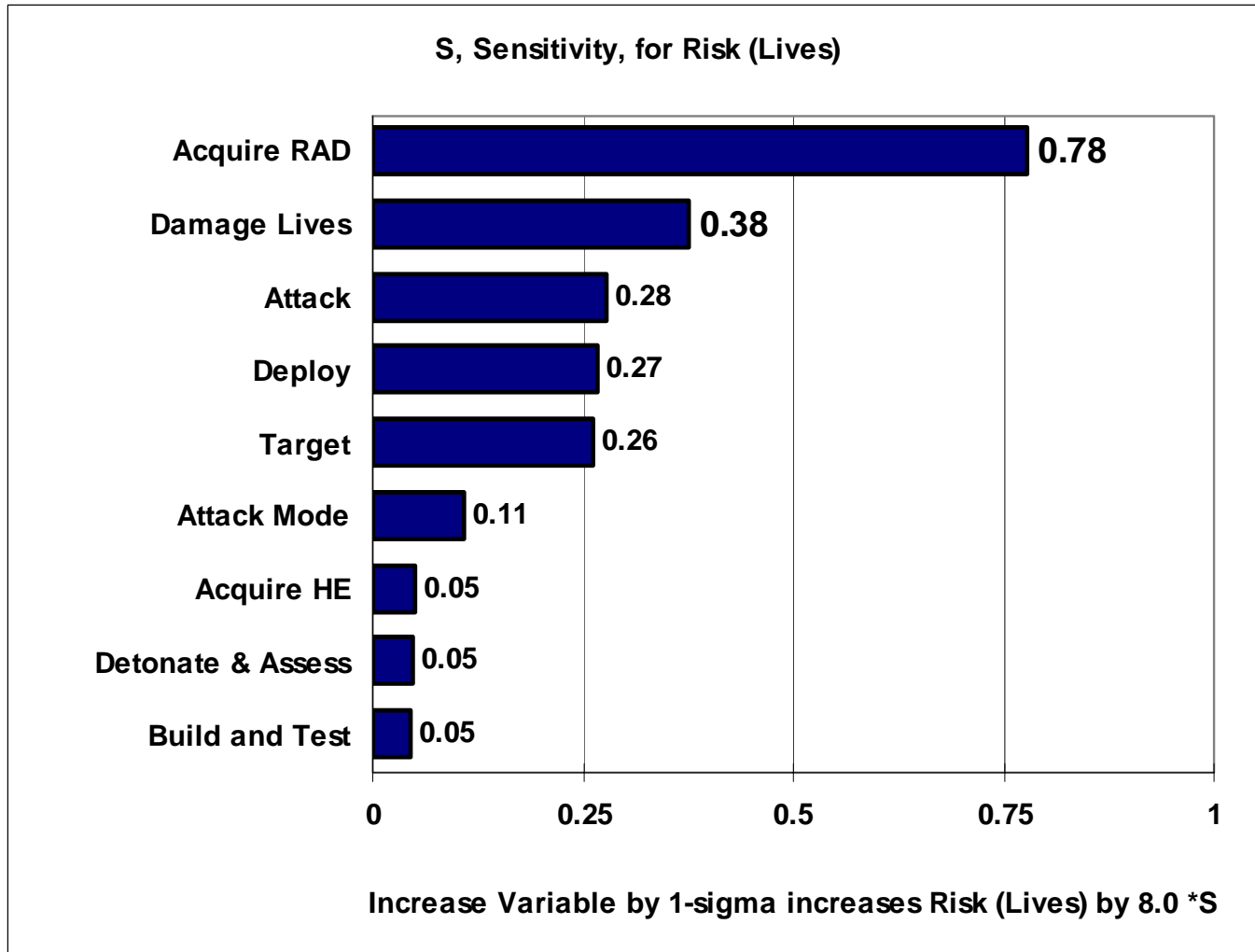


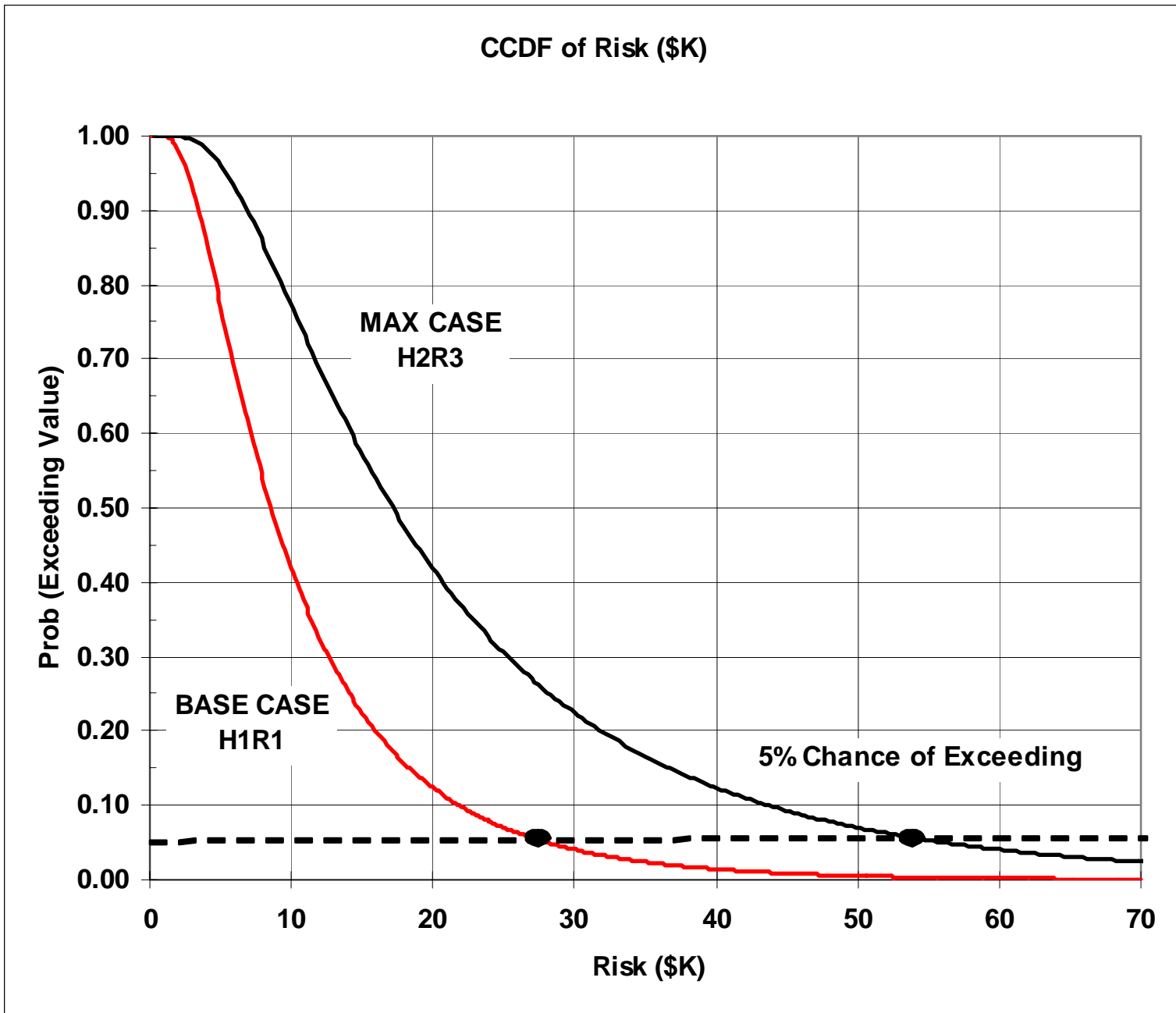
CCDF of Risk (Lives)





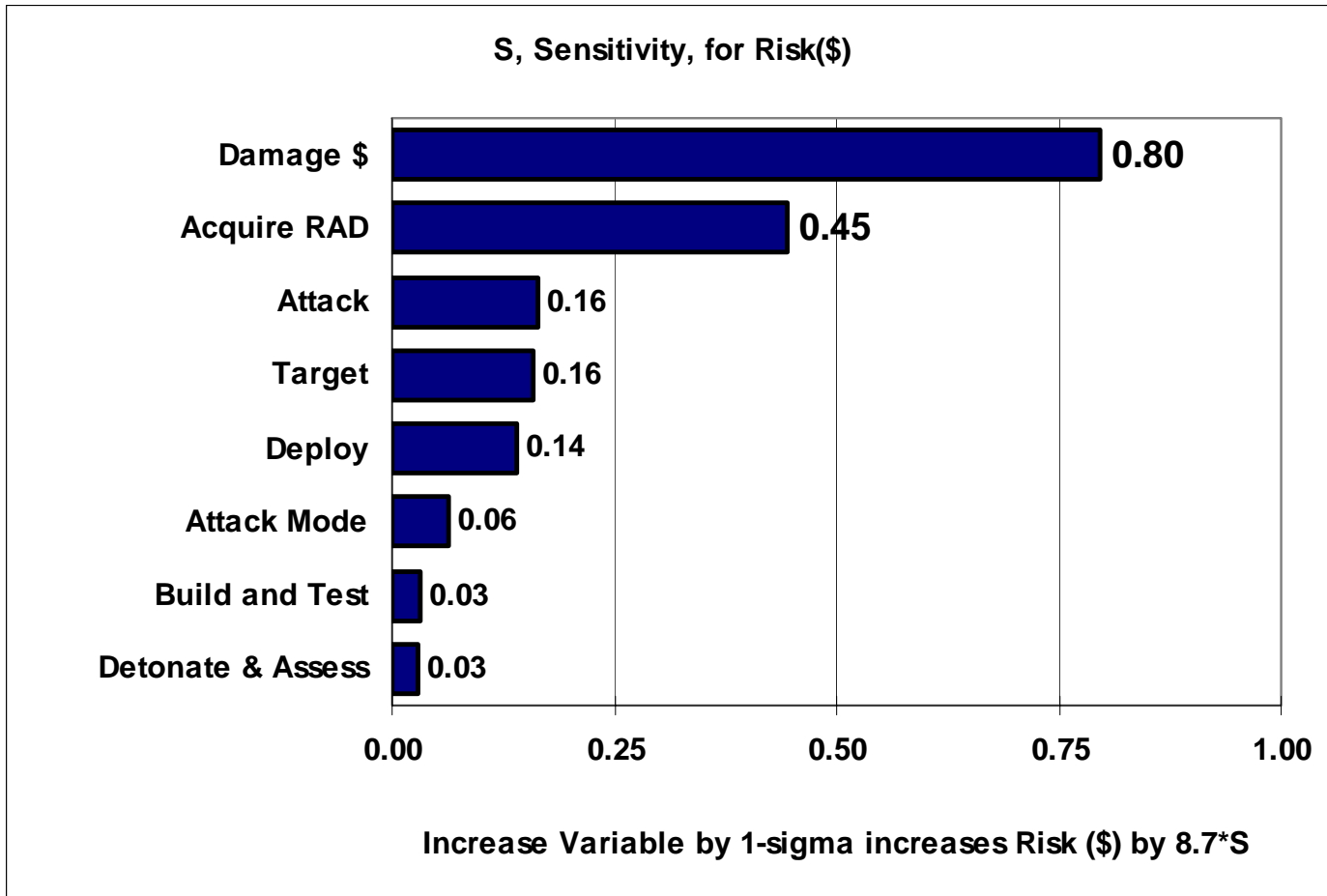
Risk (Lives) Drivers







Risk (\$) Drivers





Conclusions

- RDD risk can be modeled
- Need to ensure model:
 - ✓ Reflects operational complexities
 - ✓ Contains NO arbitrary/unjustified assumptions
 - ✓ Contain NO erroneous or misleading data
 - ✓ Uses appropriate statistical techniques
 - ✓ Applies consistent risk estimation sub-models
- RDD risk must make sense