



2008-06-07

# Critical Infrastructure Protection Metrics and Tools; Probabilistic Project Management for a Terrorist Planning a Dirty Bomb Attack on a Major US Port [June 5-7, 2008] [video]



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**Dudley Knox Library / Naval Postgraduate School  
411 Dyer Road / 1 University Circle  
Monterey, California USA 93943**



***Probabilistic Project  
Management for a Terrorist  
Planning a Dirty Bomb  
Attack on a Major US Port***

**Workshop on Critical Infrastructure Protection**

**June 5-7, 2008**

**Center for Risk and Economic Analysis of  
Terrorism Events**

**Richard John and Heather Rosoff  
University of Southern California**

# Why Study Terrorists Objectives and Values?

- Current methods for terrorism risk assessment focus on:
  - Target Vulnerability
  - Terrorist Capabilities and Resources
  - Possible Attack Consequences
- Too many potential threats to defend against all possible attacks
- Potential waste of national resources to defend unlikely targets
- Leads to “over defense” of some targets and “under defense” of other targets
- Zero sum game: Resources expended on unlikely targets reduces resources available to defend more likely targets
- Cannot ignore probability of attack.

# Terrorism vs. Technological and Natural Disaster Analyses

- Difficult to predict specific time and location of technological and natural disasters
- Yet, we attempt to characterize the probability of technological and natural disaster events
  - Earthquakes – Seismic geological studies
  - Hurricane – Oceanographic studies
  - Industrial accident – Risk studies
- None of these studies predict a specific time or location of an event in advance of its occurrence

# Proxy Value Modeling: General Approach

- Studying beliefs and motivations of terrorist leaders
  - Beliefs: What do terrorist leaders believe about the likely outcomes of specific attacks?
  - Motivations: What are the values and objectives of terrorist leaders?
- Using published writings by and about terrorist leaders to infer beliefs and motivations
- Interviewing those who understand terrorist leaders
  - Intelligence experts
  - People who understand and/or empathize with terrorist leaders

# Proxy Value Modeling: Analytic Approach

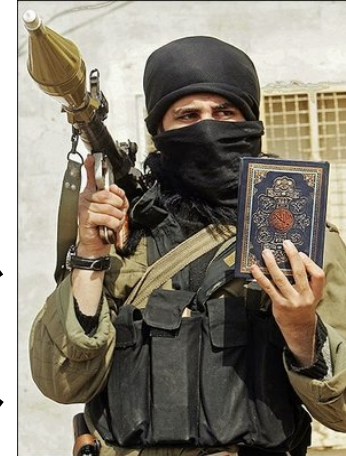
- Identify terrorist leader as a rational decision maker (CEO)
- Conduct proxy value-focused thinking for terrorist leaders
  - Means-ends diagrams
  - Objectives hierarchy
- Construct a multi-attribute utility model for evaluating terrorist attacks using the proxy objectives hierarchy
- Construct event tree for attack scenario
- Use distributions to describe uncertainty about terrorist beliefs about attack outcomes (including terrorist uncertainties)
- Use distributions to describe uncertainty about terrorist risk attitude
- Use distributions to describe uncertainty about terrorist trade-offs among conflicting objectives
- Use a random utility model to relate relative desirability of an attack alternative to likelihood of terrorist leaders selecting a particular attack alternative



Intelligence Experts

Writings  
Actions  
Speeches

Elicitation

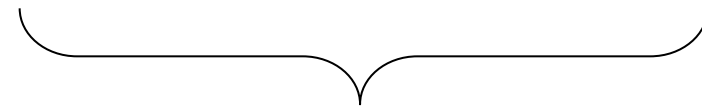
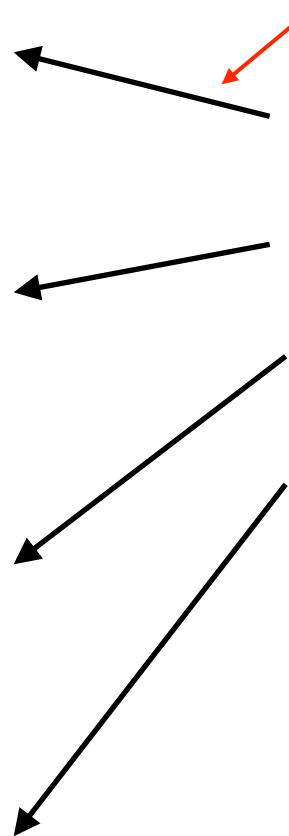
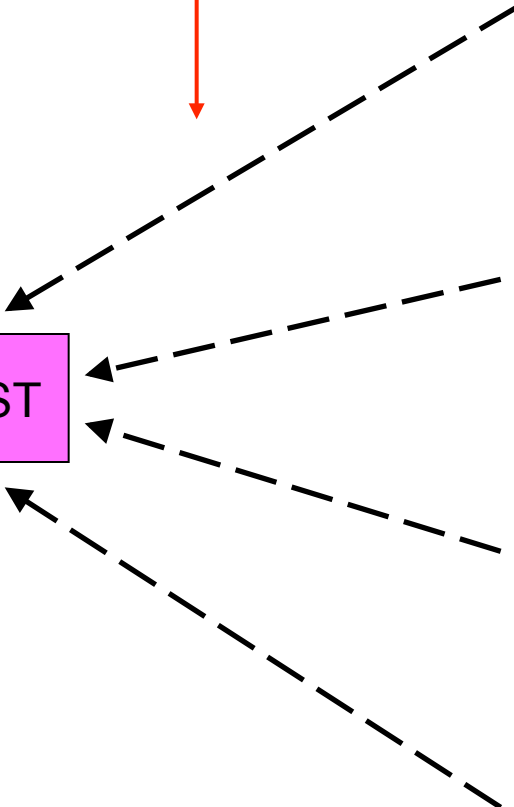


Values

Options

Beliefs

ANALYST



Choice about what attack to develop, attack capability, and whether to strike.

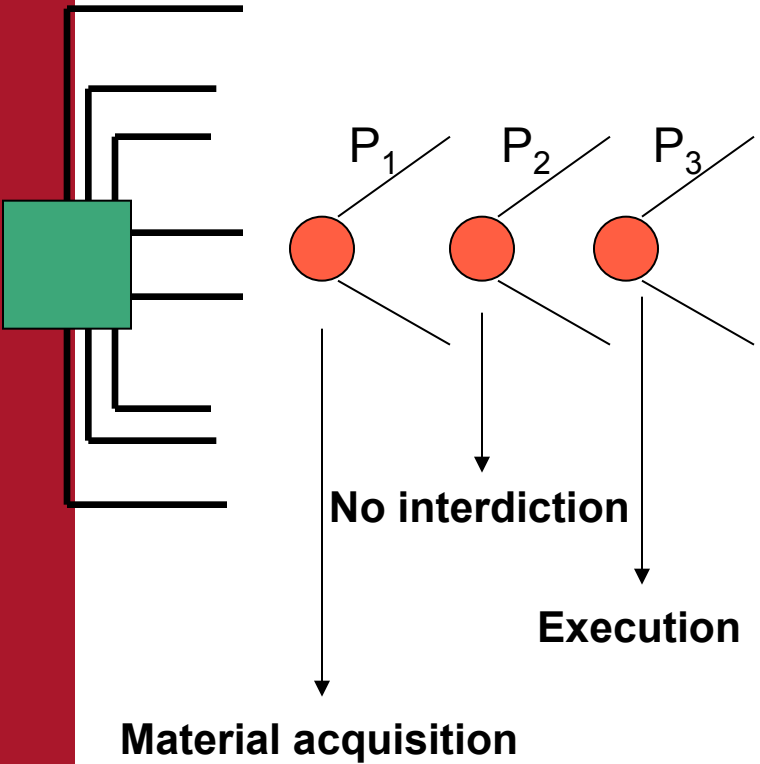
Decision analysis for the terrorist by proxy

(1) Attack Alternatives

(2) Decision Tree

(3) Value Elicitation

= Prob Estimates



- NINE attack alternatives:
  - No attack (baseline)
  - IED attack
  - Dam failure
  - MANPADS attack
  - Port Nuc attack
  - Explosion on mass transport
  - Anthrax release
  - Dirty bomb attack
  - Smallpox attack

#1

#2

#3

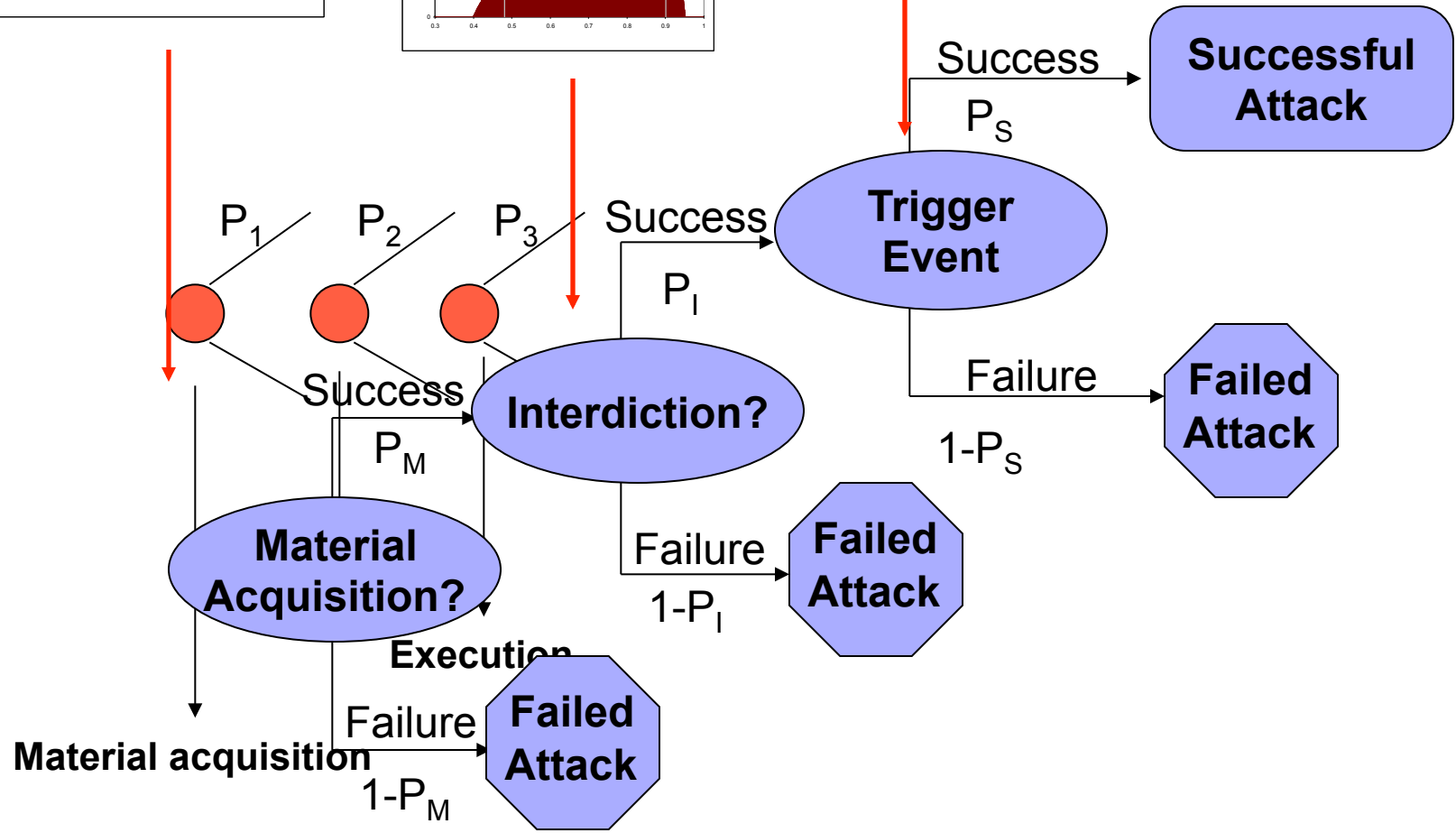
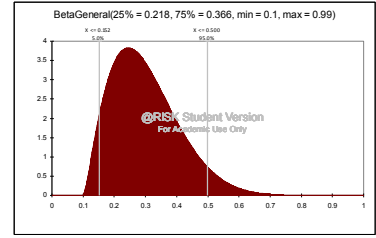
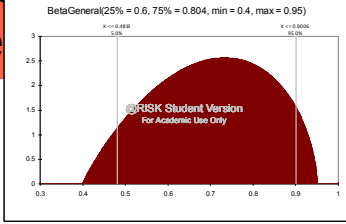
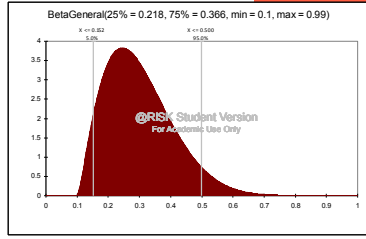
#4

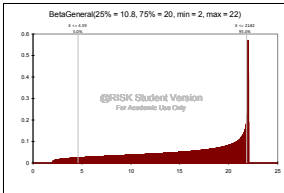
Analysts elicit the values and uncertainties for each attribute for each attack alternative.



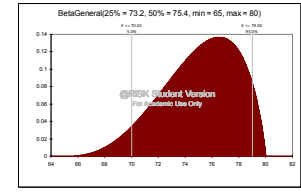
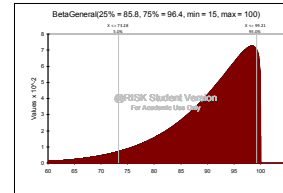
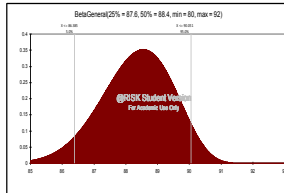


# Decision Tree



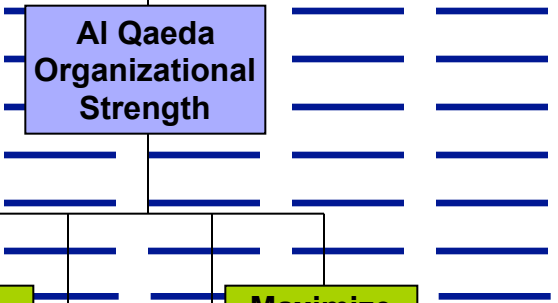


Value  
ation



**Preferred Terrorist Attack**

**Scales for each attribute**



**Operational Expenditures**

**Impact on the United States**

Maximize recruitment

Maximize funding

Minimize cost

Minimize resources

Economic impact

Instill fear

Human casualties

ST immediate damage

LT ripple effects

Analysts elicited the constraints for each attack alternative.

Maximize pop. support (sympathizers)

Minimize "backlash" To Al Qaeda

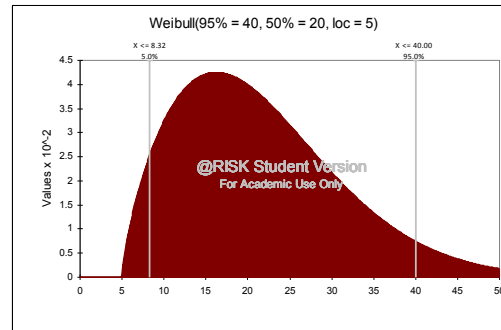
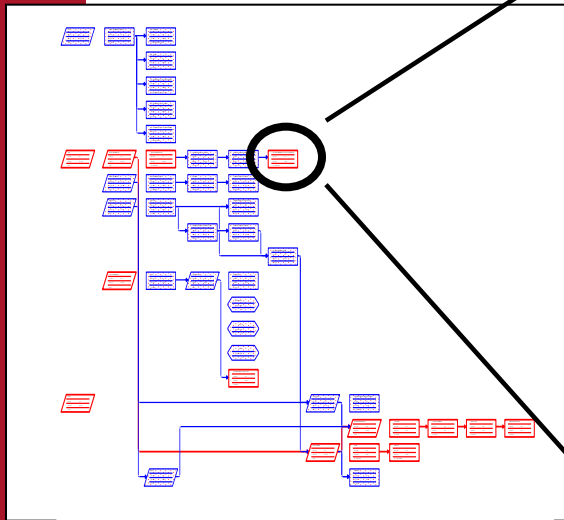
Two outputs: Use project to define critical path and uncertainty over time/resource

**Step 1:**  
Attack Duration Analysis

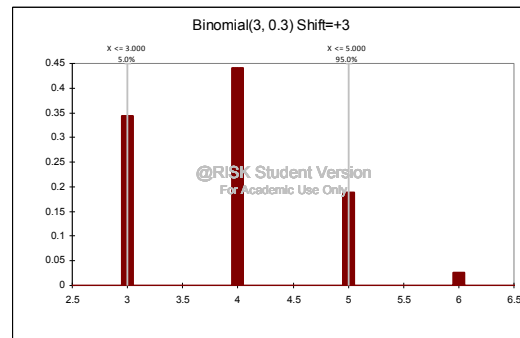
**Step 2:**  
Elicit Critical Task Time &  
Resource Variability

**Step 3: PRODUCT**  
Estimate of Total Attack Duration

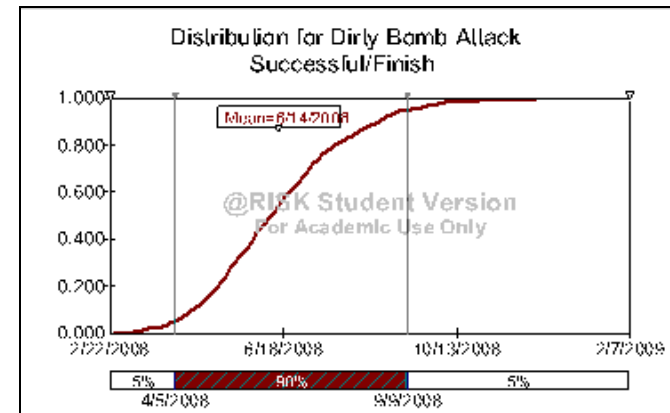
**Attack Analysis**



**Task Time**



**Task Resources**

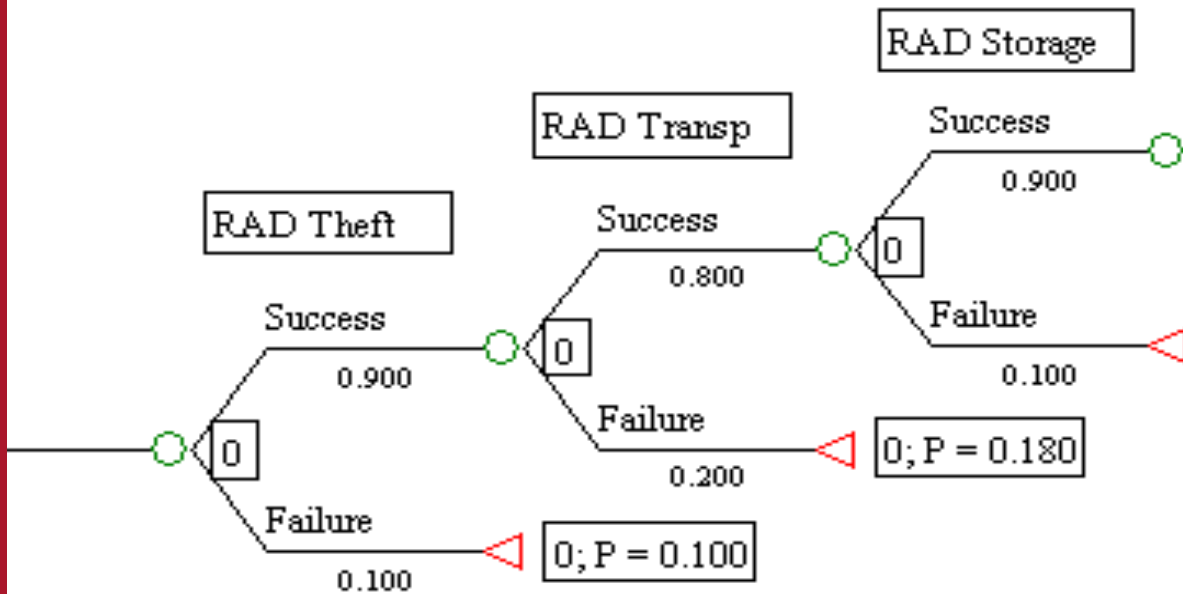


**Total Attack Duration**

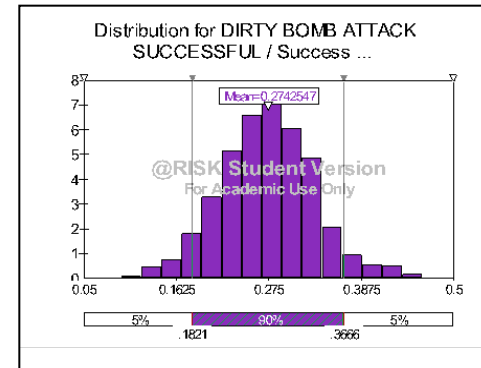
Two outputs: Probability of success – decomposed tasks to assess vulnerability affecting success probability

Each critical task's success varies by resources & time to completion

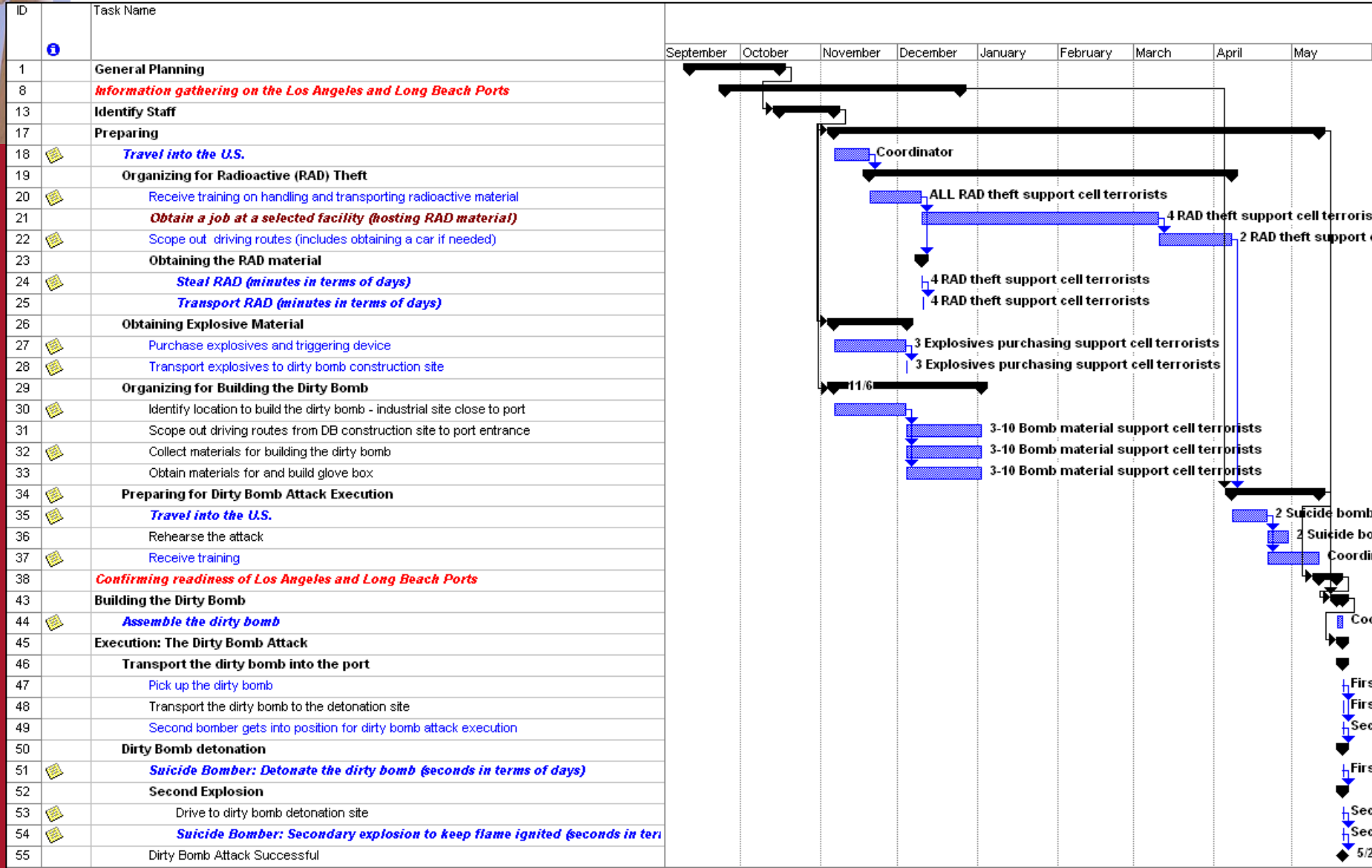
Tasks piece together to produce an overall success probability



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# 10K Project

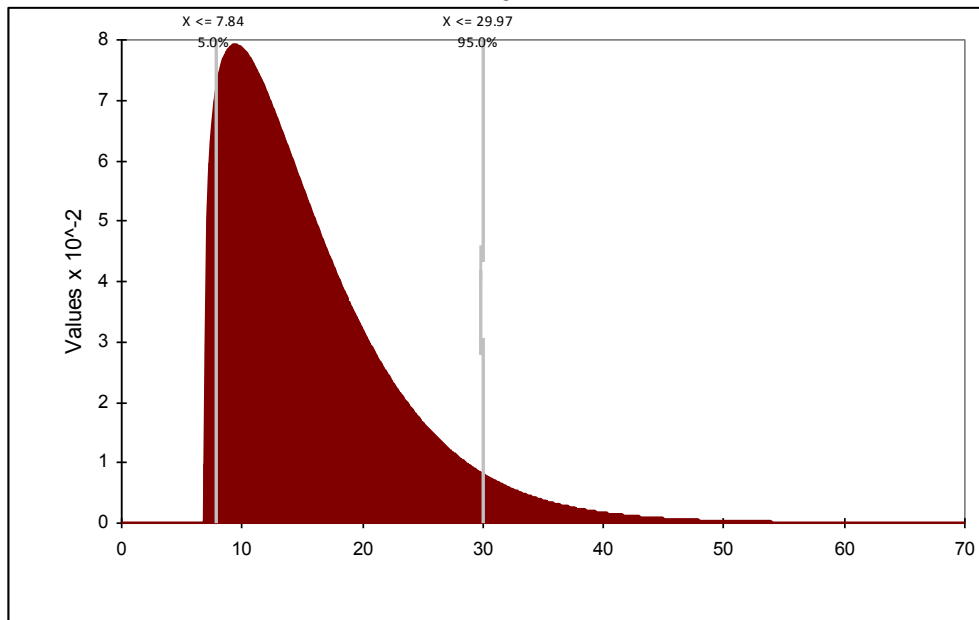


# Table of all uncertain tasks on critical path with substantial uncertainty

Task	Duration Estimates			
	Minimum	Median	95%	Maximum
Introduce idea and initiate plans for a dirty bomb attack (days)	7	14	25	infinity
Information gathering on the ports of Los Angeles & Long Beach (days)	60	90	180	infinity
Identify support cells in Los Angeles (days)	14	21	30	infinity
Identify two suicide bombers (days)	14	21	30	infinity
Travel into the U.S. (days)	7	14	30	infinity
Receive training on how to handle radioactive material (days)	5	20	40	infinity
Obtain a job at selected facility hosting RAD material (days)	14	90	180	infinity
Scope out driving routes from job to bomb construction site (days)	10	28	45	infinity
Travel into the U.S. (days)	7	14	30	infinity
Rehearse the attack (days)	4	8	14	infinity
Receive training on dirty bomb construction (days)	5	20	40	infinity

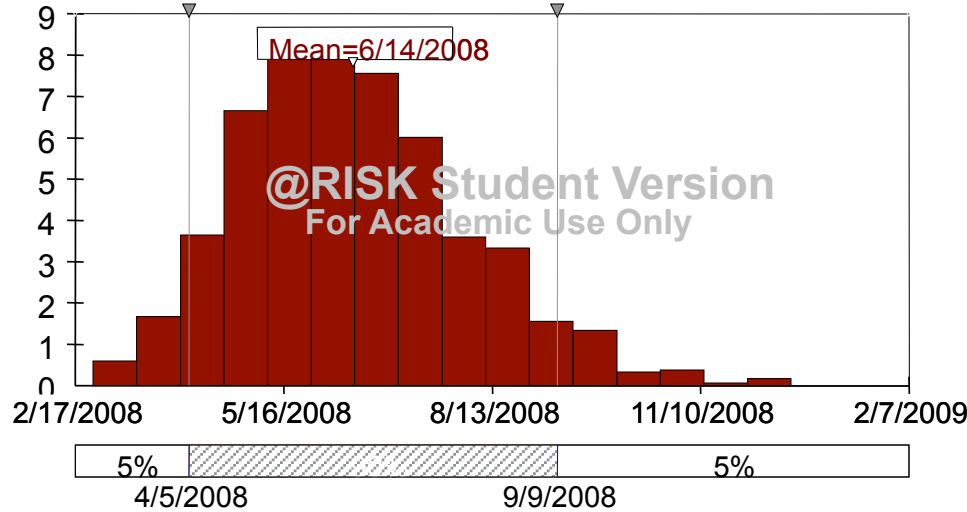
## Travel into the U.S. Uncertainty

10K Project



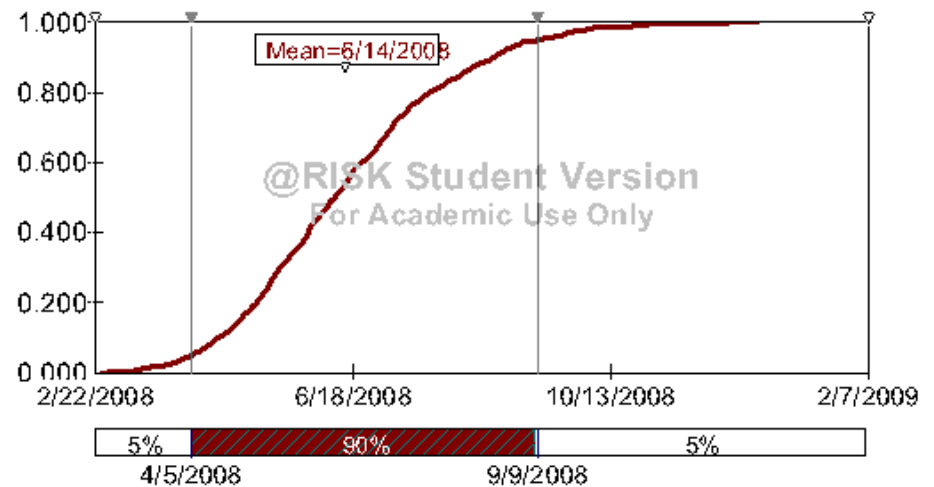
Results of Project – distribution over time...density and cumulative

Distribution for Dirty Bomb Attack Successful/Finish



10K Project

Distribution for Dirty Bomb Attack Successful/Finish



## 10K Project

Probability table of all tasks relevant to interdiction)

Task	Example Mode of Interdiction
Information gathering on the ports of Los Angeles & Long Beach (days)	Security's uncertainty about the terrorist's frequency at or around the port(s)
Receive training on how to handle radioactive material (days)	Family notes burn marks on terrorist's skin and change in their behavior
Travel into the U.S. (days)	Bombers purchase of one way tickets concerns airport screeners
Obtain a job at selected facility hosting RAD material (days)	Supervisor finds the terrorist's work behavior/actions suspicious
Steal radioactive material (RAD) (days)	Colleague witnesses terrorist during theft of RAD
Transport RAD (minutes)	Reports of stolen RAD leads to enhanced police patrol and road blocks
Travel into the U.S. (days)	Bombers purchase of one way tickets concerns airport screeners
Assemble the dirty bomb (days)	Neighbor reports questionable activity in the late evening hours
Transport the dirty bomb to the detonation site (minutes)	Police radiation devices detect RAD emitting from the terrorist's vehicle
Suicide Bomber: Detonate the dirty bomb (seconds)	Port security detects suspicious vehicle in unauthorized region of the port
Suicide Bomber: Secondary explosion (seconds)	Emergency response efforts detain the terrorist prior to bomb detonation



# Distributions over time and resources for tasks

## 10K Project

### Time

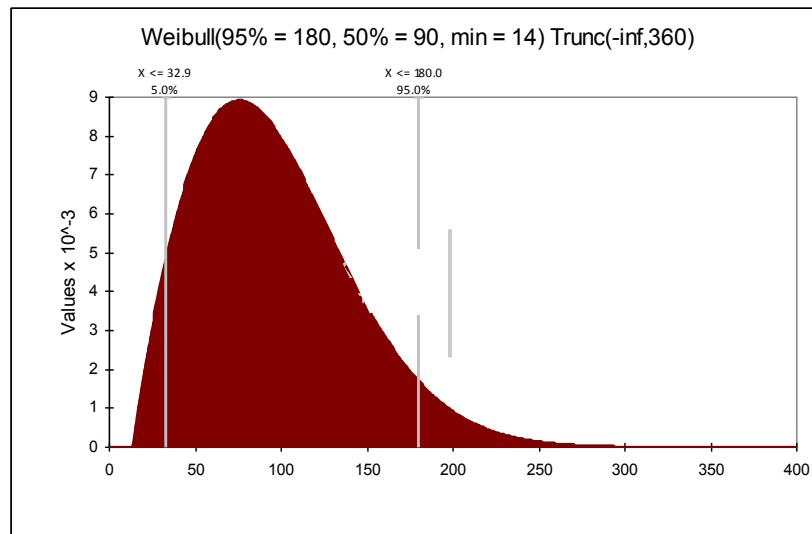
Task	Duration Estimates			
	Minimum	Median	95%	Maximum
Information gathering on the ports of Los Angeles & Long Beach (days)	60	90	180	360
Receive training on how to handle radioactive material (days)	5	20	40	infinity
Travel into the U.S. (days)	7	14	30	60
Obtain a job at selected facility hosting RAD material (days)	14	90	180	360
Steal radioactive material (RAD) (days)	30	90	180	300
Transport RAD (minutes)	45	90	180	240
Travel into the U.S. (days)	7	14	30	60
Assemble the dirty bomb (days)	1.5	2.2	3	5
Transport the dirty bomb to the detonation site (minutes)	20	45	90	150
Suicide Bomber: Detonate the dirty bomb (seconds)	60	90	180	240
Suicide Bomber: Secondary explosion (seconds)	15	30	45	90

### Resources

Task	Best Guess	Prob (Norm)
Information gathering on the ports of Los Angeles & Long Beach (days)	4	0.1
Receive training on how to handle radioactive material (days)	3	0.3
Travel into the U.S. (days)	1	0.4
Obtain a job at selected facility hosting RAD material (days)	1	0.5
Steal radioactive material (RAD) (days)	3	0.7
Transport RAD (minutes)	3	0.7
Travel into the U.S. (days)	2	0.3
Assemble the dirty bomb (days)	4	0.3
Transport the dirty bomb to the detonation site (minutes)	2	0.9
Suicide Bomber: Detonate the dirty bomb (seconds)	2	0.9
Suicide Bomber: Secondary explosion (seconds)	2	0.1

## 10K Project

Time distribution: Obtaining a job at selected facility hosting RAD material



## 10K Project

**Log odds of task success,**

**Where:  $p$  = success probability**

**$1-p$  = detection probability**

(1) Log odds of success:  $\text{Log}(p/1-p) = b_t(\text{time}) + b_r(\text{resource}) + c_{\text{constant}}$

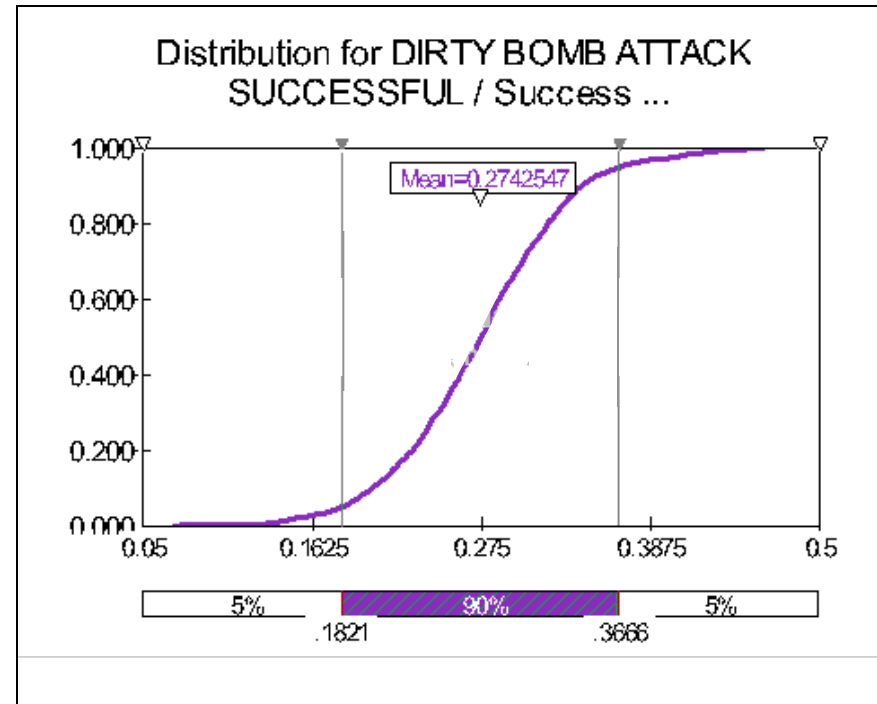
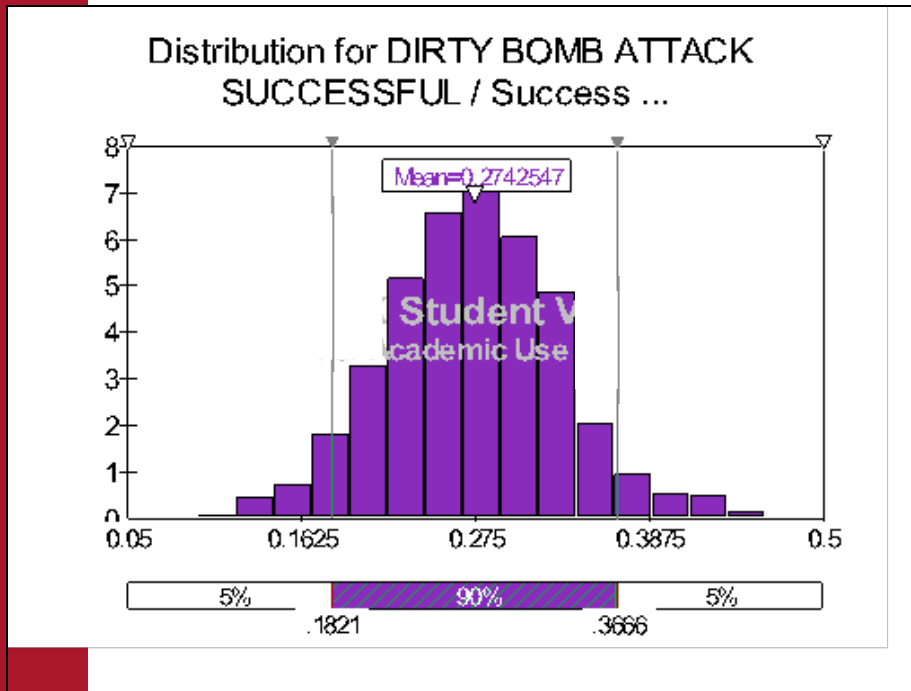
(2) Calculate  $b_t$ ,  $b_r$ , & intercept:  $(p/1-p) = e^{b(\text{time}) + b(\text{resource}) + c}$

(3) Calculate:  $P(\text{probability of task success}) = \frac{e^{b(\text{time}) + b(\text{resource}) + c}}{1 + e^{b(\text{time}) + b(\text{resource}) + c}}$

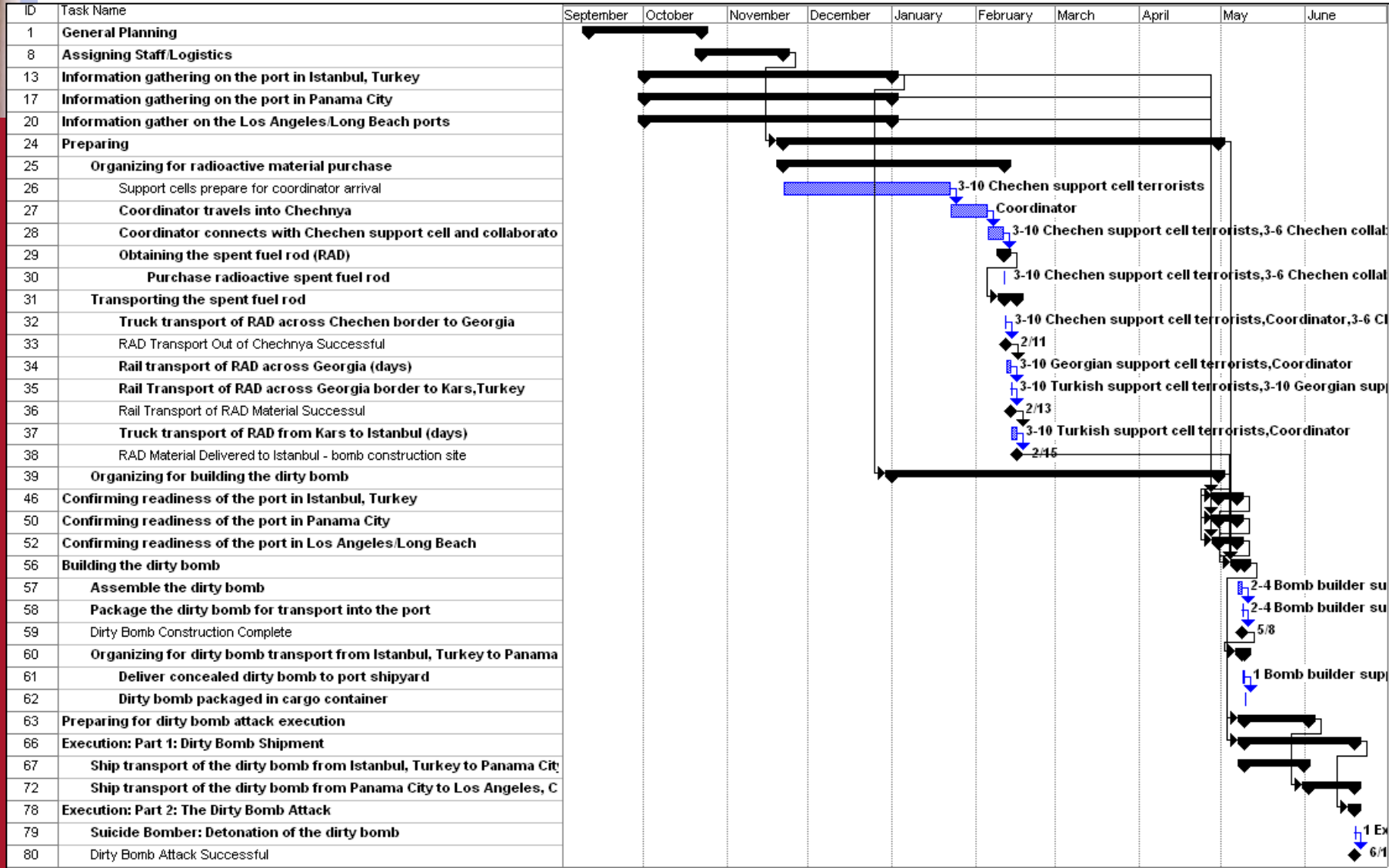
10K Project

Density distribution

Cumulative distribution



# Spent Fuel Project



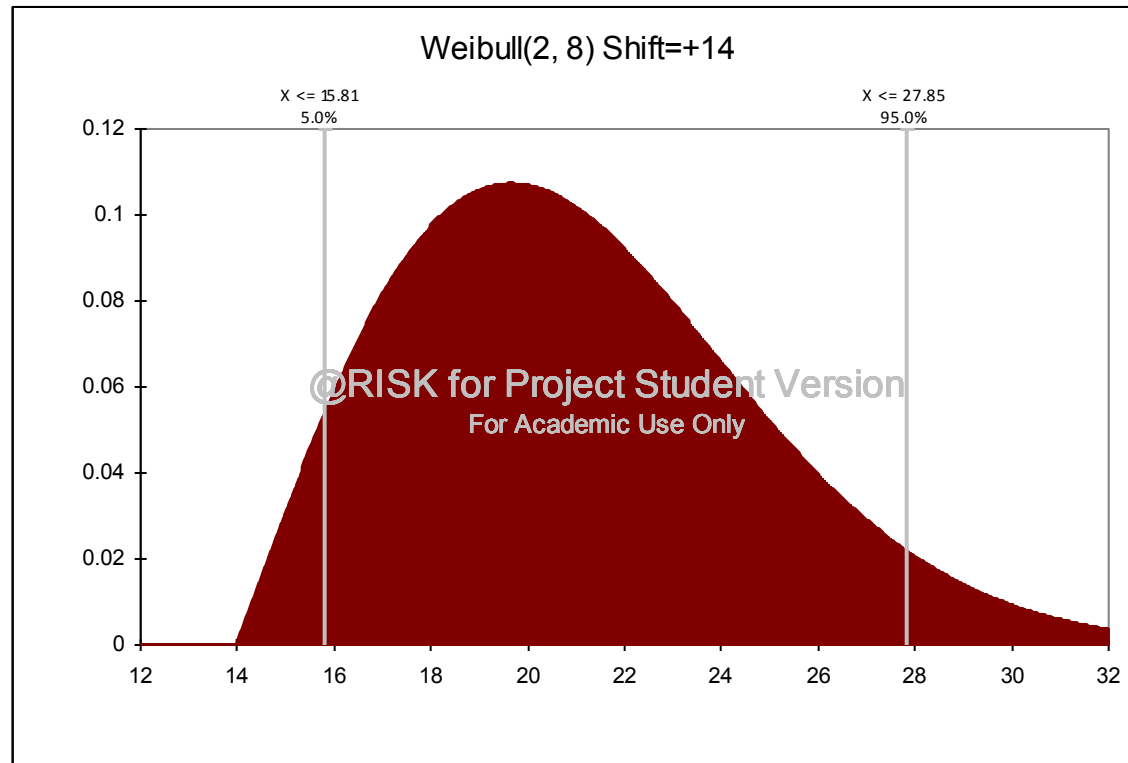
## Spent Fuel Project

### Project table of tasks with durations

Task	Duration Estimates			
	Minimum	Median	95%	Maximum
Introduce idea and initiate plans for a dirty bomb attack (days)	7	14	25	infinity
Identify support cells for phase 2 (preparing) and 3 (execution) (days)	20	30	60	infinity
Identify two executioners (days)	14	21	30	infinity
Identify collaborators in Chechnya to assist in obtaining RAD (days)	14	21	30	infinity
Information gathering on the port in Istanbul, Turkey (days)	30	67	108	infinity
Information gathering on the port in Panama City (days)	30	67	108	infinity
Information gathering on the ports of LA & Long Beach (days)	30	67	108	infinity
Coordinator travels to Chechnya (days)	2	4	10	infinity
Coordinator connects with Chechen support cell & collaborators (days)	2	3	5.5	infinity
Rail transport of RAD across Georgia (days)	1	2	4	infinity
Truck transport of RAD from Kars to Istanbul (days)	1	2	4	infinity
Bomb builders travel into Turkey (days)	2	4	10	infinity
Training of persons involved with bomb building (days)	7	15	30	infinity
Assemble the dirty bomb (days)	2.5	4	6	infinity
Deliver concealed dirty bomb to the port shipyard (days)	0.25	0.54	0.92	infinity
Suicide bomber travels into Panama City (days)	2	4	10	infinity
Rehearse/prepare for the attack while in Panama City (days)	4	9	14	infinity
Suicide bomber boards cargo containing the dirty bomb (days)	0.42	0.71	0.83	infinity

## Spent Fuel Project

Task: Establish point of contact for confirming dirty bomb & suicide bomber transport status



## Spent Fuel Project

## Poisson Explanation

**Poisson and exponential determination of task success,**

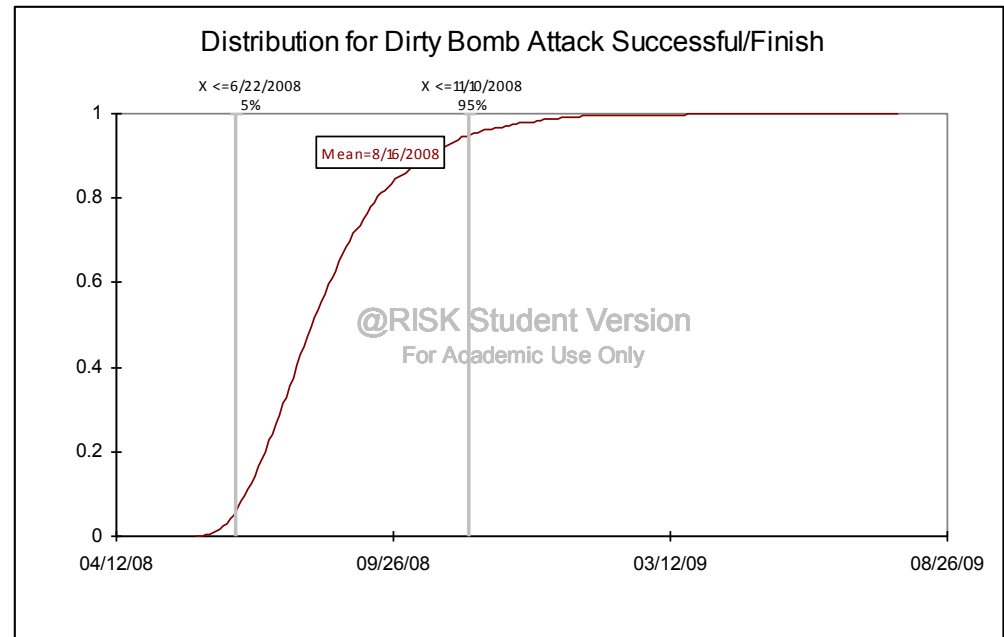
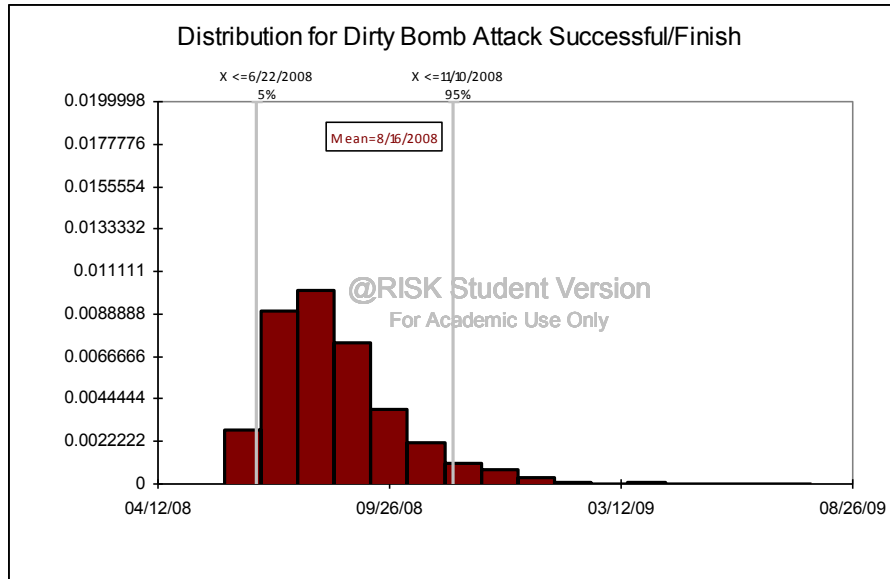
**Where:**

- (1) Calculate lambda:  $-\text{LN}(\text{Probability of task success} / \text{Base time})$
- (2) Calculate probability of detection:  $1 - e^{(-\text{lambda} * \text{time distribution})}$
- (3) Calculate probability of success:  $1 - \text{probability of event}$



## Spent Fuel Project

### Spent fuel rod project results





## Spent Fuel Project

Task	Example Mode of Interdiction
Information gathering on the port in Istanbul, Turkey (days)	Security's uncertainty about the terrorist's frequency at or around the port
Panama City: Scope out security procedures at the port (days)	Security's uncertainty about the terrorist's frequency at or around the port
Panama City: Establish point of contact (days)	Intelligence officials intercept electronic communication (email or cell phone)
Los Angeles: Identify optimal time and location for detonating the dirty bomb (days)	Security's uncertainty about the terrorist's frequency at or around the port(s)
Los Angeles: Scope out security procedures at the port (days)	Tourists in the vicinity reports suspicious persons in the port vicinity
Los Angeles: Establish point of contact (days)	Intelligence officials intercept electronic communication (email or cell phone)
Coordinator travels into Chechnya (days)	Airport security identifies the coordinator on the international watch list
Purchase fuel rod and travel out of Chechnya to Georgia (days)	Intelligence officials become apprised of purchase plans and raid the meeting
Rail transport of RAD across Georgia (days)	Train delays or random security checks result in RAD material detection
Truck transport of RAD from Kars to Istanbul (days)	Security officials detect RAD material in truck during routine patrols
Bomb builders travel into Turkey (days)	Airport screeners detain bomb builders following a random search
Assemble the dirty bomb (days)	Neighbor reports questionable activity in the late evening hours
Suicide bomber travels into Panama City (days)	Bombers purchase of one way tickets concerns airport screeners
Dirty bomb travels from Istanbul to Panama City (days)	Cargo inspectors detect RAD material aboard the ship
Suicide bomber boards cargo containing the dirty bomb (days)	Port security discovers the terrorist within an unauthorized region of the port
Dirty bomb travels from Panama City to Los Angeles (days)	Cargo inspectors detect RAD material aboard the ship
Suicide Bomber: Detonation of the dirty bomb (days)	Port security discovers the terrorist within an unauthorized region of the port

# Spent Fuel Project

## Spent fuel rod risk model vulnerable tasks

Task	Duration Estimates		
	Minimum	Median	95%
Introduce idea and initiate plans for a dirty bomb attack (days)	7	14	25
Identify support cells for phase 2 (preparing) and 3 (execution) (days)	20	30	60
Identify two suicide bombers (days)	14	21	30
Identify two executioners (days)	14	21	30
Identify collaborators in Chechnya to assist in obtaining RAD (days)	14	21	30
Information gathering on the port in Istanbul, Turkey (days)	30	67	108
Information gathering on the port in Panama City (days)	30	67	108
Information gathering on the ports of LA & Long Beach (days)	30	67	108
Coordinator travels to Chechnya (days)	2	4	10
Coordinator connects with Chechen support cell & collaborators (days)	2	3	5.5
Rail transport of RAD across Georgia (days)	1	2	4
Truck transport of RAD from Kars to Istanbul (days)	1	2	4
Bomb builders travel into Turkey (days)	2	4	10
Training of persons involved with bomb building (days)	7	15	30
Assemble the dirty bomb (days)	2.5	4	6
Deliver concealed dirty bomb to the port shipyard (days)	0.25	0.54	0.92
Suicide bomber travels into Panama City (days)	2	4	10
Rehearse/prepare for the attack while in Panama City (days)	4	9	14
Suicide bomber boards cargo containing the dirty bomb (days)	0.42	0.71	0.83

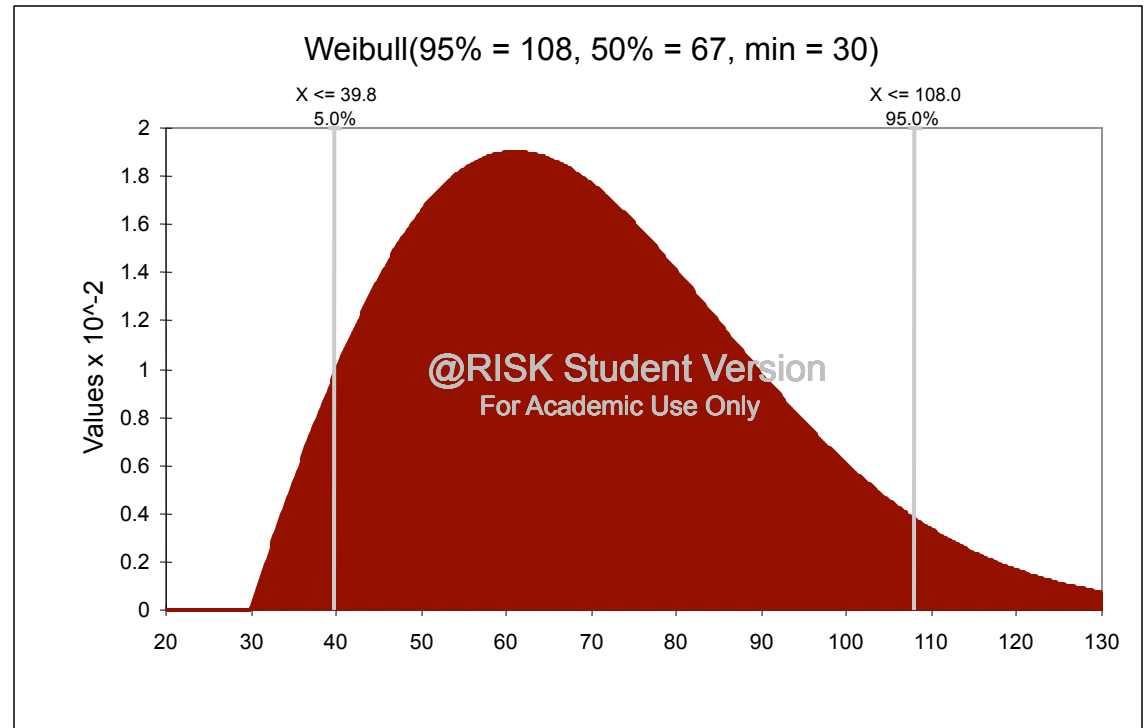
Task	Duration Estimates			
	Minimum	Median	95%	Maximum
Information gathering on the port in Istanbul, Turkey (days)	30	67	108	infinity
Panama City: Scope out security procedures at the port (days)	30	67	108	infinity
Panama City: Establish point of contact (days)	14	21	28	infinity
Los Angeles: Identify optimal time and location for detonating the dirty bomb (days)	30	67	108	infinity
Los Angeles: Scope out security procedures at the port (days)	30	67	108	infinity
Los Angeles: Establish point of contact (days)	14	21	28	infinity
Coordinator travels into Chechnya (days)	2	4	10	infinity
Purchase fuel rod and travel out of Chechnya to Georgia (days)	0.29	0.54	0.79	infinity
Rail transport of RAD across Georgia (days)	1	2	4	infinity
Truck transport of RAD from Kars to Istanbul (days)	1	2	4	infinity
Bomb builders travel into Turkey (days)	2	4	10	infinity
Assemble the dirty bomb (days)	2.5	4	6	infinity
Suicide bomber travels into Panama City (days)	2	4	10	infinity
Dirty bomb travels from Istanbul to Panama City (days)	21	24	27	infinity
Suicide bomber boards cargo containing the dirty bomb (days)	0.42	0.71	0.83	infinity
Dirty bomb travels from Panama City to Los Angeles (days)	15	18	22	infinity
Suicide Bomber: Detonation of the dirty bomb (days)	0.02	0.03	0.08	infinity

## Spent Fuel Project

Task	Base success		
	Base time	probability	Lambda
Information gathering on the port in Istanbul, Turkey (days)	67	0.95	0.0008
Panama City: Scope out security procedures at the port (days)	67	0.9	0.0016
Panama City: Establish point of contact (days)	21	0.95	0.0024
Los Angeles: Identify optimal time and location for detonating the dirty bomb (days)	67	0.9	0.0016
Los Angeles: Scope out security procedures at the port (days)	67	0.9	0.0016
Los Angeles: Establish point of contact (days)	21	0.95	0.0024
Coordinator travels into Chechnya (days)	4	0.95	0.0128
Purchase fuel rod and travel out of Chechnya to Georgia (days)	0.8	0.9	0.1317
Rail transport of RAD across Georgia (days)	2	0.8	0.1116
Truck transport of RAD from Kars to Istanbul (days)	2	0.9	0.0527
Bomb builders travel into Turkey (days)	4	0.9	0.0263
Assemble the dirty bomb (days)	4	0.95	0.0128
Suicide bomber travels into Panama City (days)	4	0.9	0.0263
Dirty bomb travels from Istanbul to Panama City (days)	24	0.85	0.0068
Suicide bomber boards cargo containing the dirty bomb (days)	0.7	0.9	0.1505
Dirty bomb travels from Panama City to Los Angeles (days)	18	0.85	0.0090
Suicide Bomber: Detonation of the dirty bomb (days)	0.03	0.9	3.5120

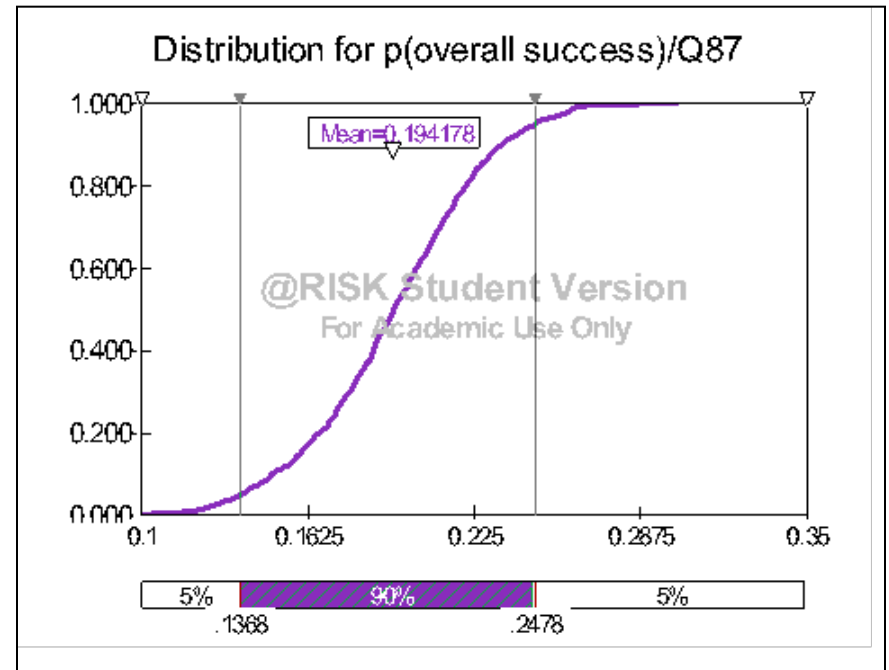
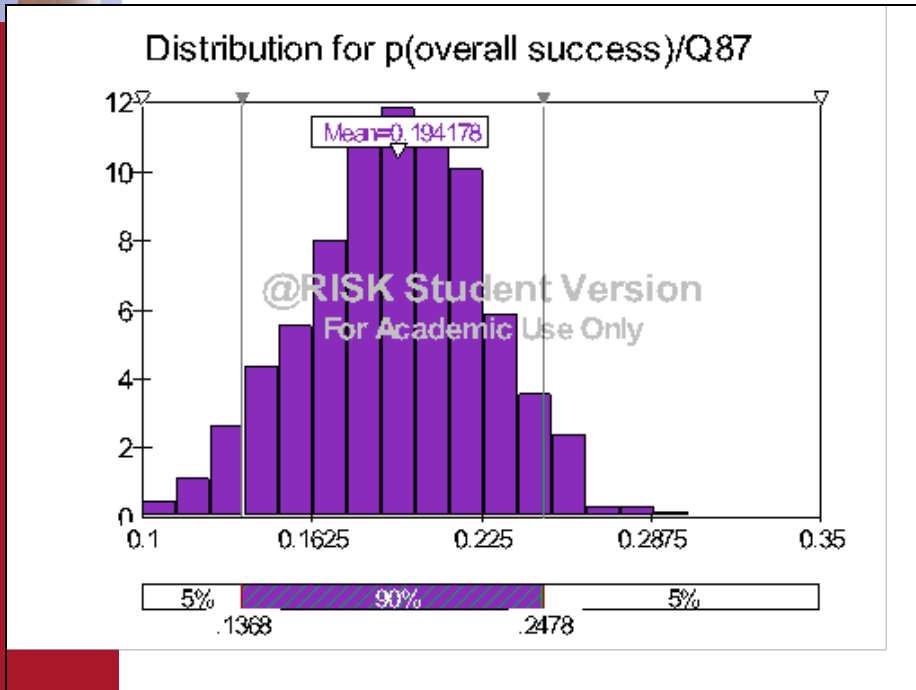
## Spent Fuel Project

Task plot: Information gathering on the port in Istanbul, Turkey



## Spent Fuel Project

## Risk Model Results





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