AWARE

SAND2008-6771P

Analyzer for Wide-Area Restoration Effectiveness

A Software Toolset for Restoration Planning, Analysis, and Decision Support

- A spreadsheet that provides a "systems" view for evaluation of the overall impact of technical resources, technology insertions or changes, available manpower, etc. on total restoration time and cost
- Incorporates all major aspects of the remediation process:
  - ***Site characterization planning***
  - ***Sampling & analysis***
  - ***Indoor and outdoor decontamination & waste handling***
  - ***Post-decon facility and outdoor area clearance***
- Developed by subject matter experts
- Incorporates Monte Carlo analyses to characterize input variable and output result uncertainties
- Enables identification of the most influential variables in the restoration process
- Can be configured with military and/or civilian asset contamination scenarios to derive restoration timeline estimates along with other restoration process metrics (e.g. cost, critical path activities, resource constraints)

Using the Tool…

- **Develop a bio-contamination scenario**
  - How large is the contaminated area and what land use categories are involved
  - You can build your own, or use pre-programmed scenarios in the tool
- **Input your anticipated restoration resources**
  - For example: number of site characterization sampling teams, analysis lab capacity, decon personnel and equipment resources, waste handling resources
  - Default values can be used as well
- **View key restoration metrics**
  - Total restoration time, cost
  - Time estimates for each phase of restoration
  - View a critical-path timeline
- **Use advanced analysis techniques (Crystal Ball® add-on)**
  - Add input variable ranges
  - Obtain estimates of output (e.g. total time) uncertainty and input parameter importance
  - Identify critical pathways and chokepoints
  - Use analysis results to optimize how restoration resources are allocated

Example Input Parameters for Restoration Phases

Characterization	Sampling & Analysis	Decontamination	Clearance
• Area of suspected contamination • Primary and secondary sample density (outdoor and indoor) • Estimate of outdoor area contaminated • Estimated number of hot buildings in contam. zone • Number of Critical Facilities • Others…	• Number of outdoor/indoor sampling teams • Indoor/outdoor sampling rate • Sample type (swab, wipe, vacuum) • Type of analysis (HTP-PCR, culture) • Lab throughput rates • Others…	• Number of indoor/outdoor decon units • Outdoor/indoor decon rate • Outdoor/indoor decon material cost • Mass of waste & sensitive equipment per facility • Waste & equipment decon rate • Others…	• Outdoor clearance sample density • Indoor clearance sample density • Sample collection rates • Lab throughput rates (culture)
12 inputs	22 inputs	100+ inputs	24 inputs

AWARE Input Screen for Indoor Characterization Phase

Indoor Characterization Defined Variables		
Phase 1 Indoor Sampling		
Contaminated blocks (Red+Yellow)	637	blocks
Buildings per block	6	buildings
Average floors per bldg	10	floors/bldg
Bldg coverage (% areal coverage of block)	60	%
Number of samples per bldg	10	samples
Average block area (sq meters)	12,000	sq meter/block
Potentially contaminated buildings	3,822	buildings
Potentially contaminated floor space	4.59E+07	sq meters
Potentially contaminated floor space	4.94E+08	sq feet
Phase 1 Indoor Sample Count	38,220	
Phase 2 Indoor Sampling		
Percentage buildings contaminated from Phase 1 screen	15	%
Number of contaminated bldgs	573	
Number of samples per sq m	0.01	samples/sq meter
Contaminated floor space	6,880,000	sq meters
	74,056,000	sq ft
Phase 2 Indoor Sample Count	68,796	

AWARE Output Screen

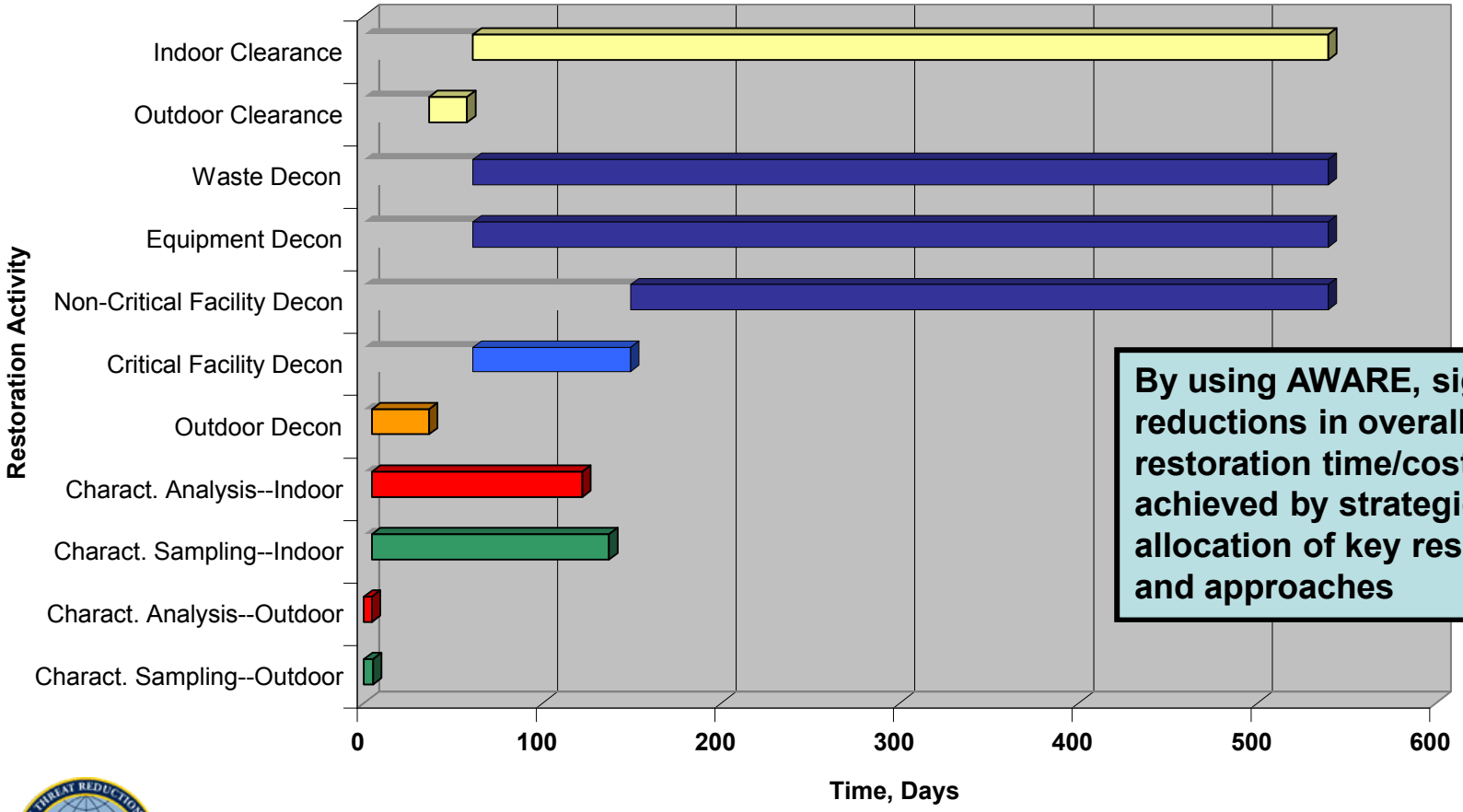
Decon Phase Time and Cost Estimates

Decon Resource Requirements	
Outdoor Street and Vehicle Decon	
Days to complete	32
Total Cost	$2,000,000
Critical Facility Decon	
Days to complete	42
Total cost	$37,290,000
Non-Critical Facility Decon	
Days to complete	407
Total cost	$2,080,040,000
Sensitive Equipment Decon	
Days to complete	299
Total cost	$52,910,000
Waste Decon	
Days to complete	282
Total cost	$76,590,000
Total Decon Time, years (sequential)	2.9
Total Cost	$2,249,000,000

AWARE Execution Time Estimates by Restoration Phase

Indoor decon and post-decon clearance activities typically have the longest timelines

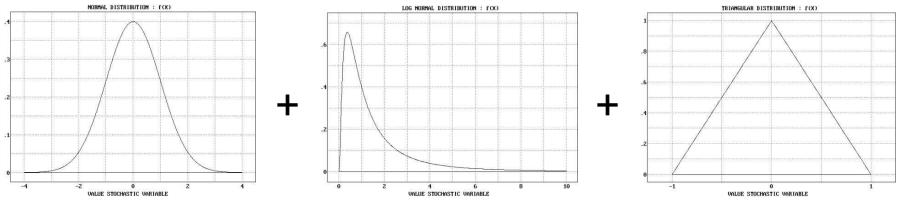
AWARE Critical Path Timeline Estimate



By using AWARE, significant reductions in overall restoration time/cost can be achieved by strategic allocation of key resources and approaches

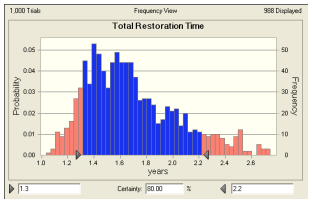
Utilizing Monte Carlo and Sensitivity Analysis Techniques to Prioritize Needs

Sample Input Parameter Distributions To Propagate Uncertainty



Perform Multiple Realizations of Scenario While Varying Input Parameters

Analyze Results and Perform Sensitivity Analyses



The Monte Carlo technique quantifies output uncertainties, while the Sensitivity Analysis techniques deduce the relative importance of the parameters from the uncertainty results.

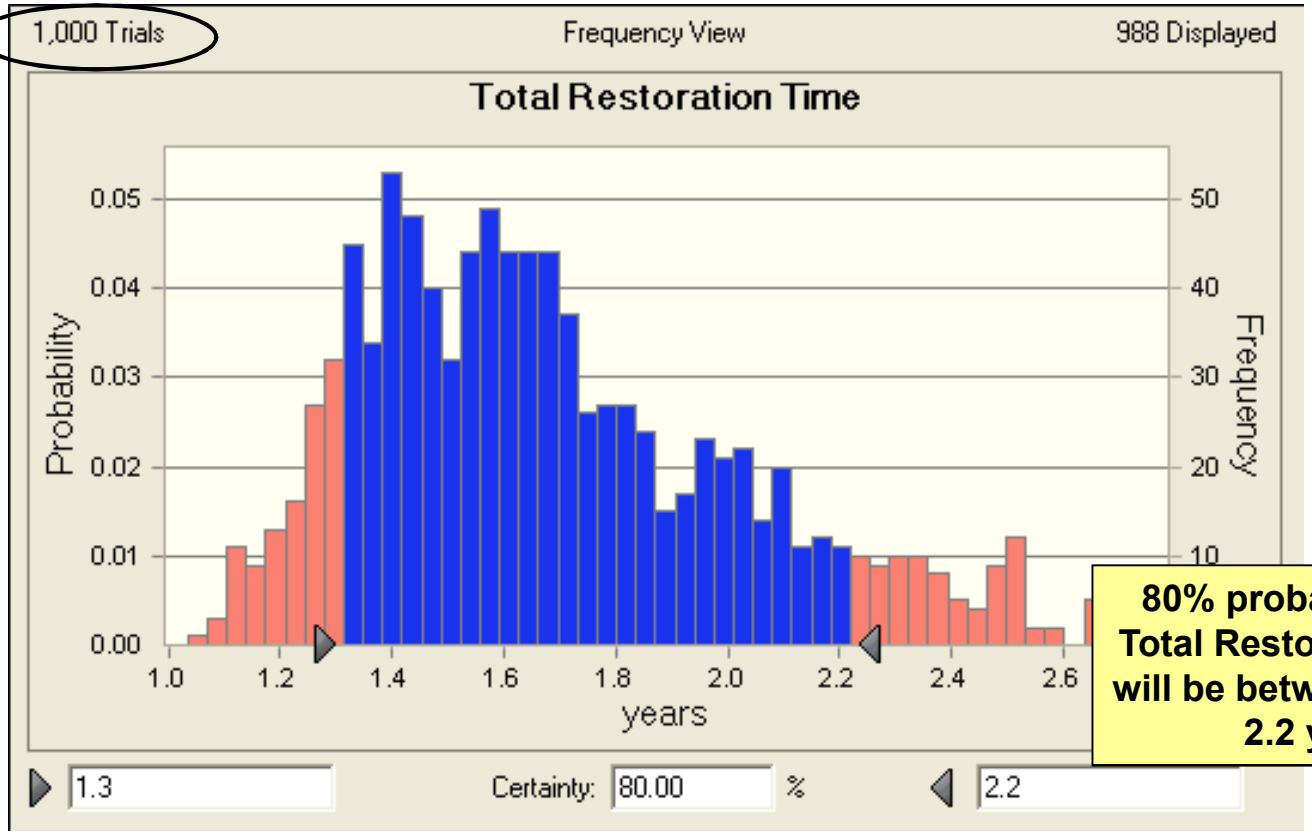
The AWARE tool is coupled with Crystal Ball® in Excel to carry out uncertainty/sensitivity analyses

Illustration of Monte Carlo Analysis Results With AWARE

Four key input variables are given ranges of values:

1) Initial bldg screening sample count **2) No. of indoor fumigation units**

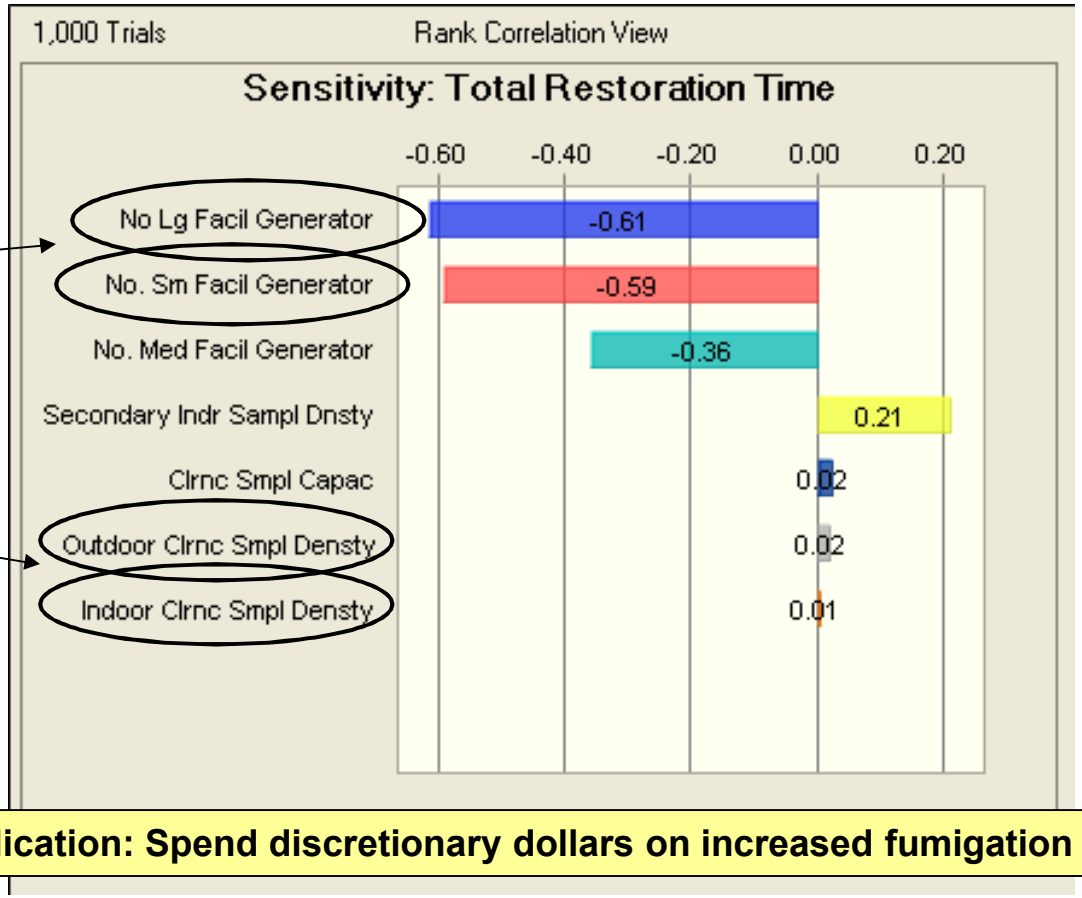
3) Post-decon clearance sample count **4) Clearance sample lab throughput**



80% probability that Total Restoration Time will be between 1.3 and 2.2 years

Illustration of Sensitivity Analysis Results Using the AWARE Tool

Using the same four input variables and ranges of values for each, determine which of them is the most influential on the overall restoration time



most

least

Increasing variable importance

Implication: Spend discretionary dollars on increased fumigation capacity

AWARE improvements are underway…

Areas either under development or planned for future development

- Improved scenario definition
- Multiple land use categories: urban, military, commercial, residential, open space, industrial etc.
- Links to other geographic information databases to determine land use codes, number and types of buildings, critical facilities
- Improved optimization (e.g. specify available resources => tool allocates these for greatest efficiency)
- Link with other IBRD products (e.g. Decision Framework) for high-level planning tool
- Expand to other-hazards planning tool…chem, rad, natural disaster
- Link with other DoD Decision Support Tools