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Title:	An Overview of NISAC/CIPDSS Activities
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Intended for:	CIPMA Canberra, Australia

Form 836 (7/06)

Abstract: An Overview of NISAC/CIPDSS Activities

This presentation will be given to the Australian homeland security staff of the CIPMA project as part of an ongoing technical exchange.

The presentation presents an overview of NISAC/CIPDSS activities since the most recent CIPMA technical exchange. It covers an overview of the CIPDSS approach to model construction, sensitivity and uncertainty analysis, and simulation. A high-level overview of recent deliverables on hurricanes, pandemic influenza and learning environment simulators is also included.

NISAC

NATIONAL INFRASTRUCTURE SIMULATION & ANALYSIS CENTER

Critical Infrastructure Protection Decision Support System

CIPDSS

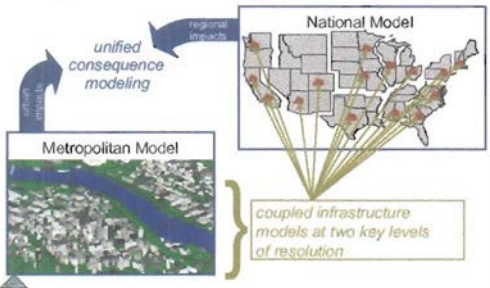
The Critical Infrastructure Protection Decision Support System

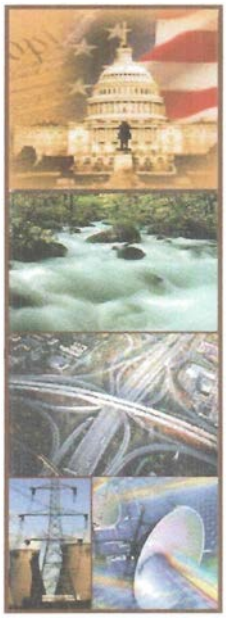
- **Suite of simulation models and analysis process**
- **Risk assessment tool and decision aid**
  - Represents all seventeen critical infrastructures and key resources in a single integrated framework
  - Decision aiding procedure that combines multiple metrics into a single measure of merit
  - Accounts for uncertainties in threats, vulnerabilities, and the consequences of disruptions
  - Mitigation alternatives compared over a range of threat or incident likelihoods
- **Consequences include primary interdependencies**
  - Models primary interdependencies among critical infrastructures and key resources
  - Calculates cascading effects into linked infrastructures and into the national economy

CIPDSS

Objectives

- Develop a risk-informed system to rapidly evaluate potential infrastructure disruptions
- Model primary interdependencies in critical infrastructures
- Estimate consequences of significant infrastructure disruptions
- Evaluate the effectiveness of mitigation options
- Support federal and regional exercises





NISAC

CIPDSS

The CIPDSS Goal: Structured, Defensible Decision Aid

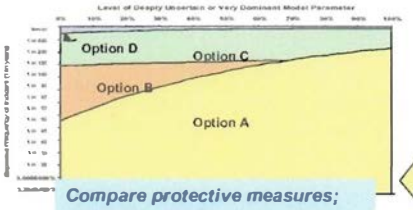
Scenario-Driven Analyses

Broad threat representation enables risk-informed decision making

Interdependent Infrastructure Models

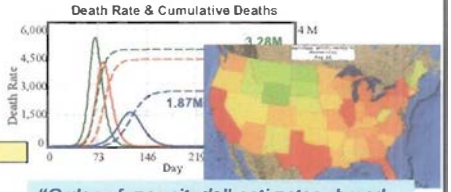
17 CI/KR and primary interdependencies; National/regional and metropolitan scale

Decision Model to Evaluate Trade-Offs



Compare protective measures; Support portfolio or overall risk reduction investment decisions

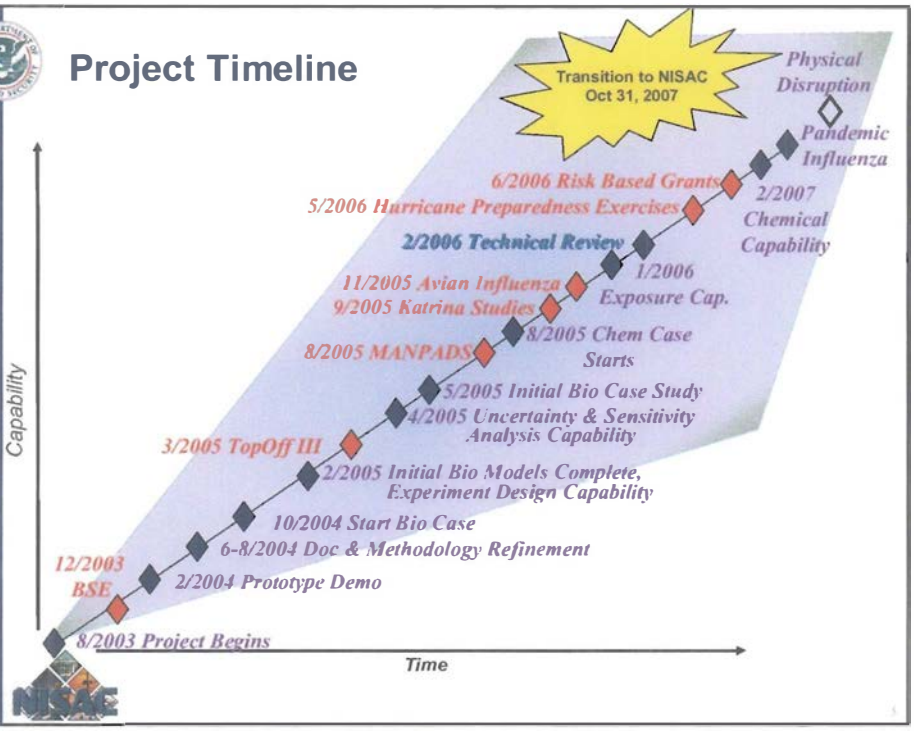
Quantify/Visualize Consequences



"Order-of-magnitude" estimates; broad uncertainty analysis

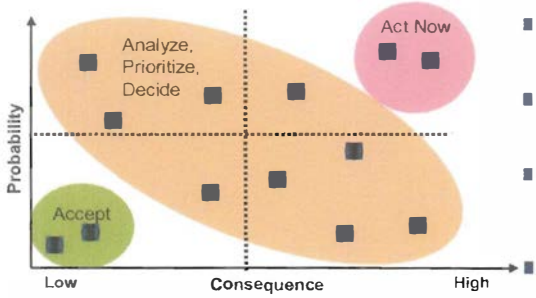
NISAC

Project Timeline



CIPDSS

The Questions Our Stakeholders Are Asking ....



- What are the *consequences* of a disruption?
- How long does it take to recover from a major event?
- Do proposed actions or policy options have unintended consequences?
- Are there disruptions that could have severe unintended consequences?
- What actions or policy choices have greatest leverage in mitigating the consequences?
- Considering threat and vulnerability, what are the highest risk areas?
- Which investment, mitigation, and research strategies can have the greatest impact in reducing overall risk?

CIPDSS

Requirements

- Provide a structured, defensible decision-aiding approach
- Broad representation of 12 Critical Infrastructures and 5 Key Resource Categories
- "Order-of-magnitude" results
- Represent primary interdependencies and visualize consequences
- Account for uncertainties in scenario and data
- Broad threat representation for risk-informed decision making
- Models should run quickly on a desktop – respond to national events

Critical Infrastructures

1. Agriculture
2. Banking and Finance
3. Chemical and Haz Mtls
4. Defense Industrial Base
5. Emergency Services
6. Energy
7. Food
8. Information and Telecom
9. Postal and Shipping
10. Public Health
11. Transportation
12. Water
13. Key Assets (5)
14. Economics
15. Government
16. Population

CIPDSS

Approach

Quantitative Consequence and Decision Modeling	• Structured, defensible decision aid
System Dynamics: Explanatory modeling Group model building	• "A mile wide and an inch deep" • Develop prototype quickly • Order of magnitude results • Run quickly on a desktop • Educate decision makers
Architecture Structure: Modularity Standardization Automation	• Defensible decision aid • Supporting diverse stakeholder base • Agility • Managing Complexity
Formalized Analysis Process	• Supportable data • Defensible decision aid
Numerical Experiment Capability	• Explicit treatment of uncertainty

CIPDSS

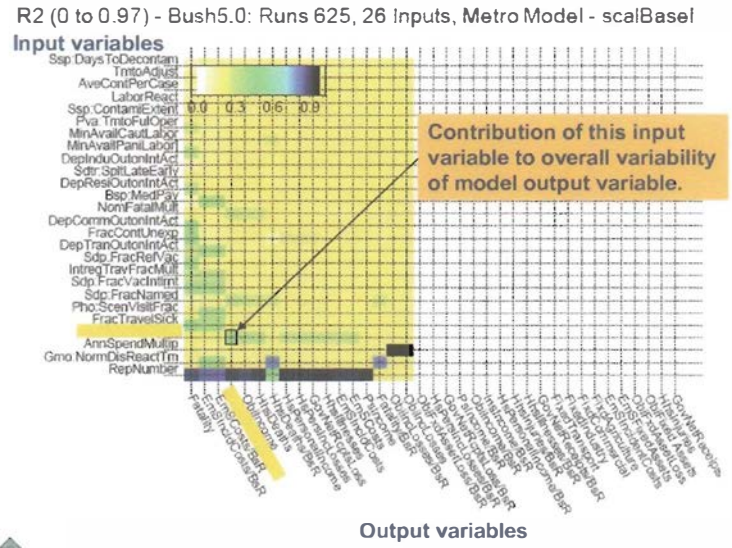
Sample Scenario

- **Infectious disease breakout in a large city**
  - Normal travel spreads disease through nation
  - Existing CDC response policies applied
- **Mitigation strategies**
  - Alt A: Bio detectors
  - Alt B: Anti-viral drug development
  - Alt C: Mandatory self-quarantine
  - Alt D: Pre-trained medical responders
- **Model outputs**
  - Deaths
  - Illnesses
  - Economic costs

CIPDSS

NISAC

Sensitivity Analysis



CIPDSS

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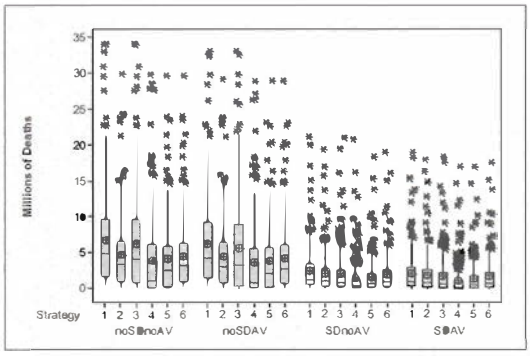
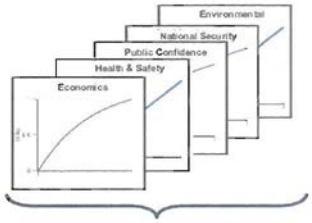
Uncertainty Analysis



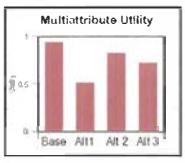
- A single point may not give the whole story
- Neither averages
- Nor means…

Multi-Attribute Decision Analysis Method

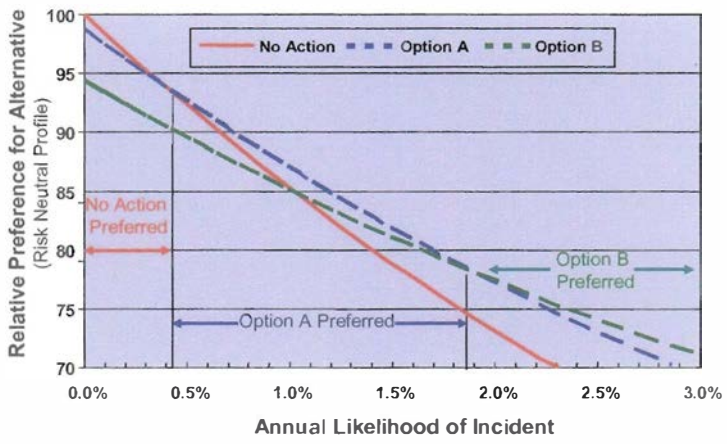


Method enables value trade-offs and preferences for different factors to be represented by an overall utility function

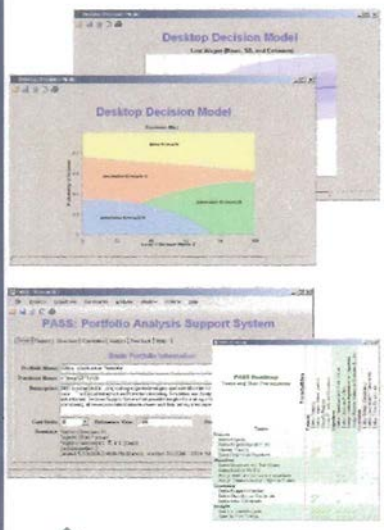
- Allows comparison and ranking of disparate consequences
- Input from many decision makers and experts will be used to develop a DHS "corporate" preference profile



Maximum Utility Suggests Preferred Alternative



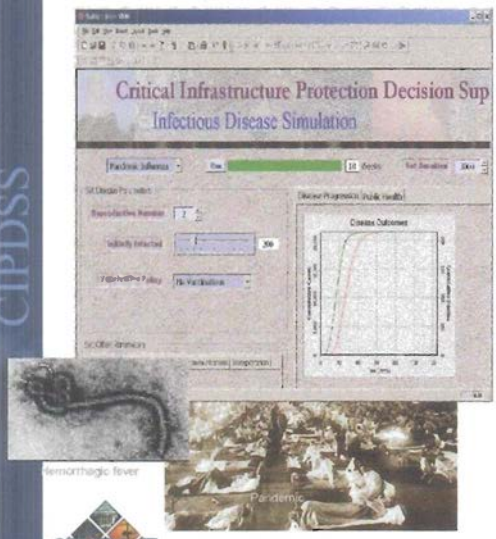
Prototype Desktop Decision Models



- **Decision Model Prototype**
  - Technical requirements defined
  - Use cases completed
  - Initial windows designed
  - QA process documented
  - 50% complete
  - On schedule to complete by September 2006
- **Portfolio Analysis Prototype**
  - Legacy system ported to Windows
  - Technical requirements defined
  - Database table designs completed
  - Use cases completed
  - Initial windows designed
  - Programmer's guide drafted
  - Optimization engine under development

CIPDSS

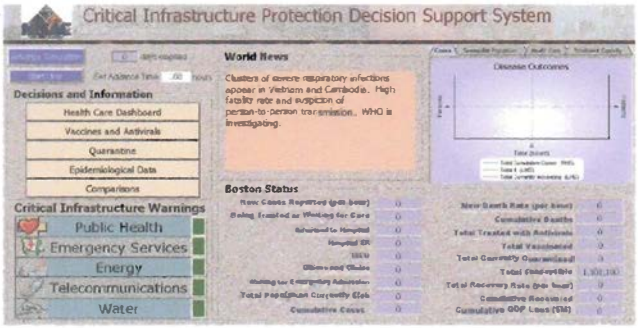
Prototype Scenario Simulator



- Purpose is to gain feedback on CIPDSS from a limited deployment of a scenario capability
- Infectious diseases selected for initial scenario
- Disease selection: pandemic influenza, smallpox, plague, Marburg's disease, and user-defined diseases
- Interdependency effects shown on tabbed display: Public Health, Emergency Services, Transportation, Economics, Telecommunications, etc.
- Metrics: total cases, deaths, lost value-added
- Status – in development

CIPDSS

Desktop Learning Environments

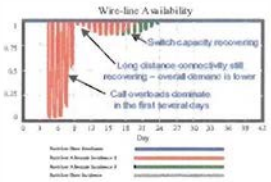


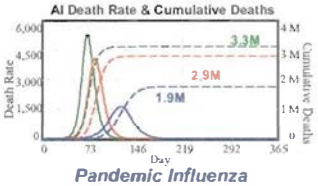
Conduct workshops for hospital administrators, first responders, state and local officials using a simulator to take participants through scenarios they may encounter; allowing them to make decisions as events occur and assess outcomes in illnesses, deaths and economic impacts

- Learning environment simulator
  - Initial version for pandemic influenza outbreaks
  - Test out strategies for events before they occur
  - Participants react to changing conditions and have access to a wide variety of response options
  - Initial test in Boston with Massachusetts General and emergency preparedness officials was well received
  - Participants found they were having conversations that they might not otherwise have

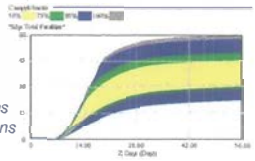
Applications

- **Telecom Scenario**
  - Loss of a major switching station in each of three cities
- **Infectious Disease Scenarios**
  - Smallpox
  - Pandemic influenza
  - Plague
- **Chemical**
  - Accidental Chlorine Release
- **Katrina Analyses**
  - Contaminated floodwaters
  - Effect of evacuees on Baton Rouge



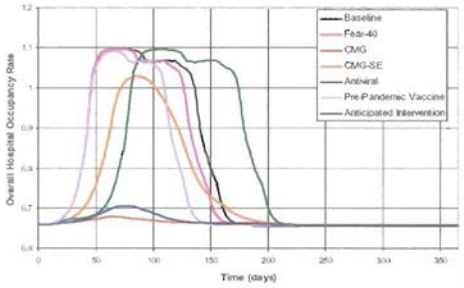


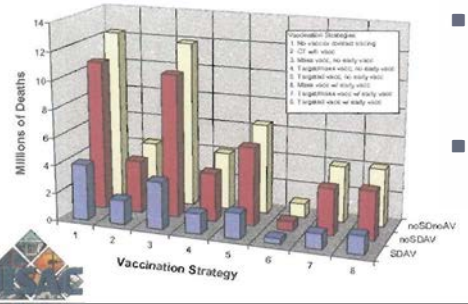
Pandemic Influenza



Uncertainty analysis of deaths due to Campylobacter infections in Katrina evacuees

Pandemic Influenza Infrastructure and Economic Impact Analysis





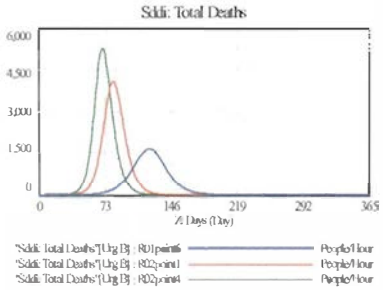
Joint NISAC-CIPDSS analysis of impacts of pandemic influenza proposed Jan 2006

Participation in DHS Consequence Assessment and Policy Working Group

- Identification of questions that need to be answered
- Identification of modeling capabilities to address the questions

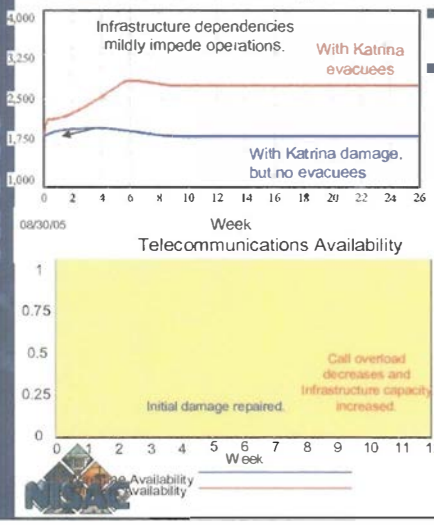
- **Completed Phase 1 Analysis November 2007**
  - Selected point cases
  - Health care impacts
- **Phase 2 Uncertainty Analysis completed**
  - Preliminary results to left – under review

Pandemic Influenza Infrastructure and Economic Impact Analysis



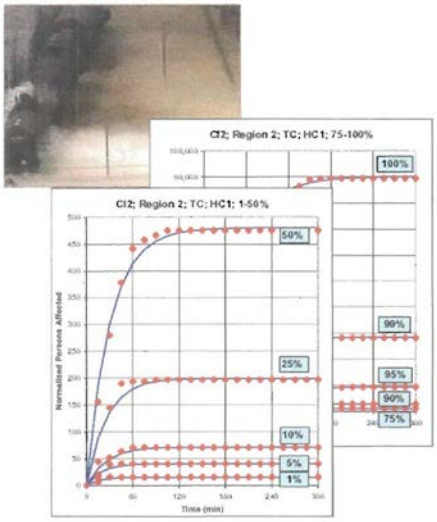
- **Joint NISAC-CIPDSS analysis of impacts of pandemic influenza proposed Jan 2006**
- **Participation in DHS Consequence Assessment and Policy Working Group**
  - Identification of questions that need to be answered
  - Identification of modeling capabilities to address the questions
- **Completed Phase 1 Analysis November 2007**
  - Selected point cases
  - Health care impacts
- **Phase 2 Uncertainty Analysis nearing completion**

Potential Impact of Hurricane Katrina Evacuees to Baton Rouge



- In just a few days the population of the Baton Rouge area increased by 200,000 (~50%); also suffered direct damage from the hurricane
- CIPDSS Metro model used to assess how infrastructures are impacted by additional demand shock as well as damage
- Highlights:
  - Electricity infrastructure appears able to absorb the expected added demand;
  - Transportation: Significant improvements to roads, traffic control and public transportation required;
  - Telecom: Capacity increases for wire-line and wireless telecommunications infrastructure required.
  - Public Health and Healthcare: Bed capacity should increase; as much as 40% more staffing required.
  - Emergency Services: EMS staff and equipment will need to be increased up to 40%.
  - Caveats: The major uncertainty is the rate at which people will move out of Baton Rouge.

Chemical/Exposure Scenario Capability

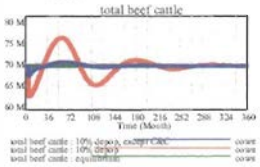


- Demonstration of capability to model consequences of hazardous chemical release and alternative mitigation measures.
- Completed time-dependent statistical exposure models based on four regional meteorology conditions.
- Completed 6-level health care allocation model based on population exposure levels.
- Enhanced metro health care and emergency services models.
- Considered a variety of improved preparedness and improved detection measures
  - No significant difference in reduction of consequences between alternative measures
  - No measure that was analyzed was found to be superior to existing capabilities

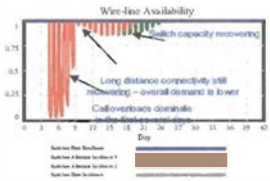
Key Insights

- **Consequences are:**
  - Situation dependent
  - Time dependent
  - Often nonlinear
- **Inventories buffer supply disruptions**
  - Coverage strongly influences how fast the government must respond
  - JIT systems reduce resiliency
- **Protecting the head of the supply chain can significantly reduce impacts**
  - FMD Scenario
- **Behavior can both dominate and either exacerbate or mitigate consequences**
  - Hoarding vs. Conservation
  - Call overload – Telecom
  - Fear-based self-isolation – biological events, pandemic flu

interdependency analysis for DHS risk calculations

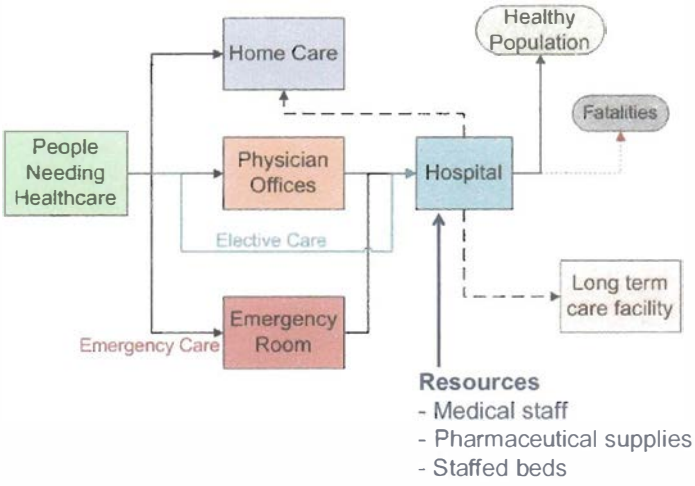


FMD Scenario



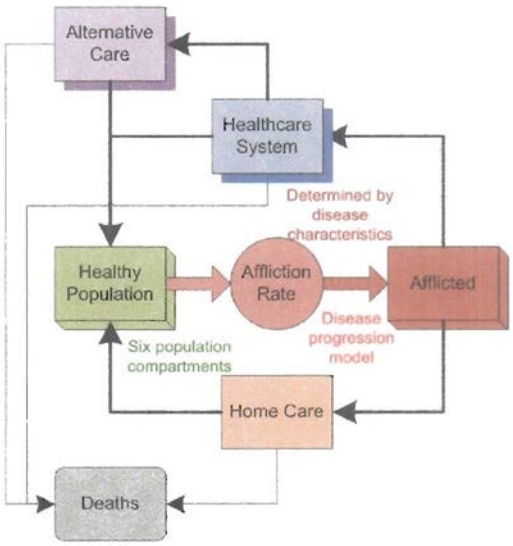
Telecom disruption scenario

Healthcare Model

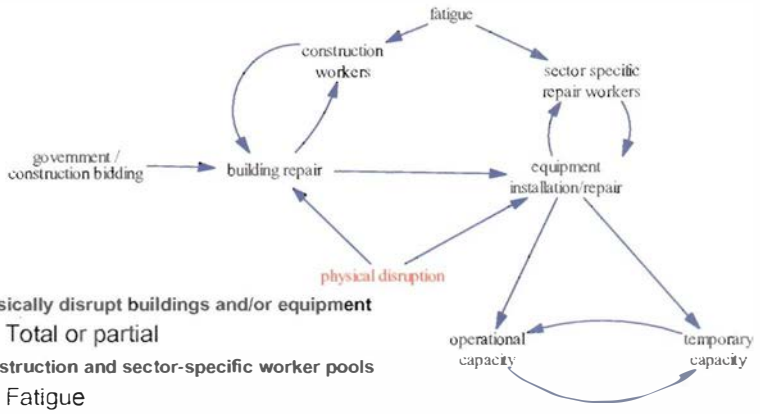


Population Model

- Healthy population becomes *afflicted*
- Six population compartments: 5 by age; one by occupation
- Afflicted people seek healthcare (or not)
- Healthcare is a separate model
- People restored to health return to Healthy Population
- Fatalities are accounted



Repair and Recovery Overview: Model Links



- Physically disrupt buildings and/or equipment
  - Total or partial
- Construction and sector-specific worker pools
  - Fatigue
- Temporary Facilities
- Bidding process delays
- Sector-specific parameters
- Calculate operational capacity over time

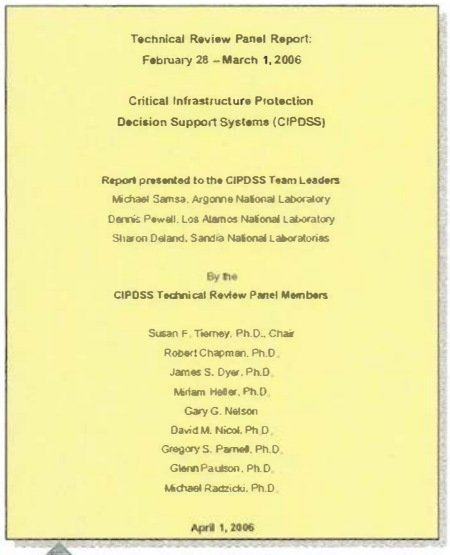
CIPDSS

Economics Modeling

- Thoroughly reviewed national economic interdependency models: documented data requirements and proposed and implemented enhancements
- Compared/contrasted CIPDSS interdependency concepts with traditional economic models
- Incorporating physical disruption analysis capability into the economics models

CIPDSS

CIPDSS Technical Review Feb/Mar 2006



Technical Review Panel Report:
February 28 – March 1, 2006

Critical Infrastructure Protection
Decision Support Systems (CIPDSS)

Report presented to the CIPDSS Team Leaders
Michael Samsa, Argonne National Laboratory
Dennis Powell, Los Alamos National Laboratory
Sharon Deland, Sandia National Laboratories

By the
CIPDSS Technical Review Panel Members

Susan F. Tierney, Ph.D., Chair
Robert Chapman, Ph.D.
James S. Dyer, Ph.D.
Miriam Heller, Ph.D.
Gary G. Nelson
David M. Nicol, Ph.D.
Gregory S. Parnell, Ph.D.
Glenn Paulson, Ph.D.
Michael Radzicki, Ph.D.

April 1, 2006

- **Technical Review of the CIPDSS Program held 2/28-3/1**
- **Reviewers had broad range of expertise:**
  - Public policy
  - System Dynamics
  - Economics
  - Decision Support
  - Public Health and Health Care
  - Cyber Security
- **Strong endorsement of technical approach and accomplishments**
  - Use of system dynamics technology
  - Explicit representation of interdependencies
  - Right level of detail
  - Level of collaboration among participating laboratories