



# **Urban Commerce and Security Study (U-CASS)**

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# Problem Statement

- *Problem:* There is often a perceived conflict between freedom of economic activity and the need for increased security. Nowhere is this more apparent than in urban areas such as Lower Manhattan
  - Conflicting goals:
    - Enhance economic activity
    - Prevent terrorist attacks
  - But, are they always conflicting?





- *Related problem arises in much more general settings involving security.*
- Example:
  - Crime outside Manhattan hotel
  - Police close off several-square-block area around hotel
  - Severe impact on business at nearby shops and restaurants





# Problem Statement

- *Related problem arises in much more general settings involving security.*
- Example:
  - Gas smell in a downtown building
  - Fire department orders evacuation of building and reroutes traffic in the neighborhood
  - Work at 100s of offices in the building and commerce in the area are severely affected





# Problem Statement

- *Related problem arises in much more general settings involving security.*
- Example:
  - Trucks entering downtown are subject to random inspection
  - Some businesses find that slows down deliveries and look to move to another city, thus having both direct and indirect economic effects





- *Related problem arises in much more general settings involving security.*
- Example:
  - High-rise apartment building installs turnstyle-type access control; residents required to carry access cards even when leaving for short time
  - Some tenants find this annoying
  - Others feel safer and may even be willing to pay more rent thanks to this





- *In such examples:*
  - Extent of security initiative can make big difference in economic impact
  - Rarely do authorities take potential economic impact into account
  - Probably appropriate not to in rapidly-developing situations
  - But, appropriate to do so in advance strategic planning





- *U-CASS aims to:*
  - Assess economic impact of security initiatives
  - Develop general approach to understanding interplay between security and commerce
  - Develop approach with wide applicability to urban areas nationwide
  - Identify ways to minimize economic impact of security initiatives
  - Identify situations where increased security enhances economic activity



# U-CASS Research Methodology

- ***Unique effort by three DHS University Centers of Excellence:***
  - ***CREATE*** (Center for Risk & Economic Analysis of Terrorist Events) – based at USC
  - ***CCICADA*** (Command, Control & Interoperability Center for Advanced Data Analysis) – based at Rutgers University
  - ***NTSCOE*** (National Transportation Security Center of Excellence) – in particular Mineta Transportation Institute based at San Jose State U.





# U-CASS Research Methodology

- ***Fundamentally multi-disciplinary approach:***
  - ***CREATE***: risk assessment and modeling of economic impact; interviewing/expert elicitation; preference/probability elicitation
  - ***CCICADA***: data analysis; measurement; simulation modeling; crime analysis; risk analysis; interviewing/expert elicitation
  - ***NTSCOE*** (Mineta): understanding terrorist events; threat analysis; threat scenario generation





# U-CASS Research Methodology

- Project begins in Lower Manhattan, including new World Trade Center site





# U-CASS Research Methodology

- However, we want to develop a widely-applicable methodology.
- Later stages of U-CASS will explore other urban areas:
  - Los Angeles
  - Chicago
  - Etc.





# U-CASS Research Methodology

- ***Numerous stakeholders have security/economic goals for downtown Manhattan; project is engaging them***
  - NYPD
  - Port Authority of NY/NJ
  - Local and state government agencies
  - Mayor's office
  - Real estate firms, financial sector firms
  - Local economic development organizations
  - Local private sector organizations (e.g., Chambers of Commerce)
  - Workers in area offices and shops
  - Residents





# U-CASS Research Methodology

- ***Stakeholders:*** For example, we have visited the NYPD Lower Manhattan Security Initiative





# U-CASS Research Methodology

- ***Stakeholders:*** For example, we have visited the new #7 WTC





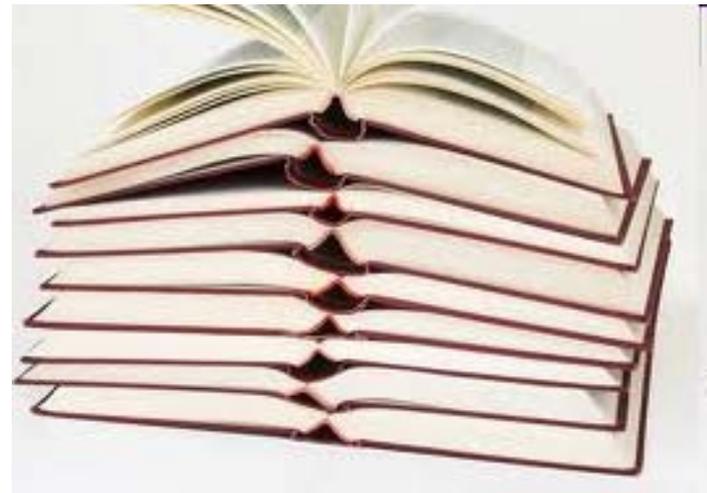
# U-CASS Research Methodology

- ***Ultimate Project Goal: Develop a decision support tool that planners and decision makers can use to make choices about security initiatives/countermeasures***
- Tool based on risk and economic analysis
- Usable to compare security measures or packages (“portfolios”) of security measures as to risk and economic consequences



# U-CASS Research Methodology

- ***Information Gathering Stage:***
  - Threats
  - Security initiatives/countermeasures
  - Scenarios
- Utilizing stakeholders, subject matter experts, literature searches





# U-CASS Research Methodology

- ***Information Gathering Stage:***

- Developing sets of alternative security initiatives/countermeasures, including:

- Video surveillance
- Screening programs
- Security perimeters-checkpoints (vehicles, pedestrians)
- Access control (neighborhoods, buildings)
- Street closures





# U-CASS Research Methodology

- ***Understanding Economic Activity in Lower Manhattan:***

- *Gathering micro-economic data about activity:*

- Rents
- Real estate transactions
- Insurance

- Gathering data about costs of “mitigation”





# U-CASS Research Methodology

- ***Understanding Economic Activity in Lower Manhattan:***

- Gathering data about costs of countermeasures:

- Capital and operating costs
- Congestion costs
- Costs of delays
- Measuring “Inconvenience”
- Environmental quality (pollution)





- ***Understanding Economic Activity in Lower Manhattan:***
  - Complexity of finding ways to quantify costs of countermeasures
  - Complexity of finding ways to gather opinions about these costs from different stakeholders
  - Example: Delays:
    - Would you pay \$10 (every day, every week, every month) to cut your commute time down by 10 minutes?
    - Would you pay \$10 (a week, a month) to avoid having to wait on line to go through a metal detector to get into your office building?



# U-CASS Research Methodology

- ***Understanding Economic Activity in Lower Manhattan:***
  - Gathering data about costs of an attack:
    - Death
    - Injury
    - Property damage
    - Damage to “icons”





# U-CASS Research Methodology

- ***Understanding Economic Activity in Lower Manhattan:***
  - Again, some of the costs of an attack are hard to measure.
  - For instance, for an icon like the WTC, you might measure the cost of rebuilding it, but the cost of its destruction is much more than the cost of another similar building because of its iconic value.
  - Related idea: In a study of the impact of terrorism on downtown Chicago office market, Dermisi (2007) noted that tenants' fears of terrorism most negatively affected "trophy buildings"





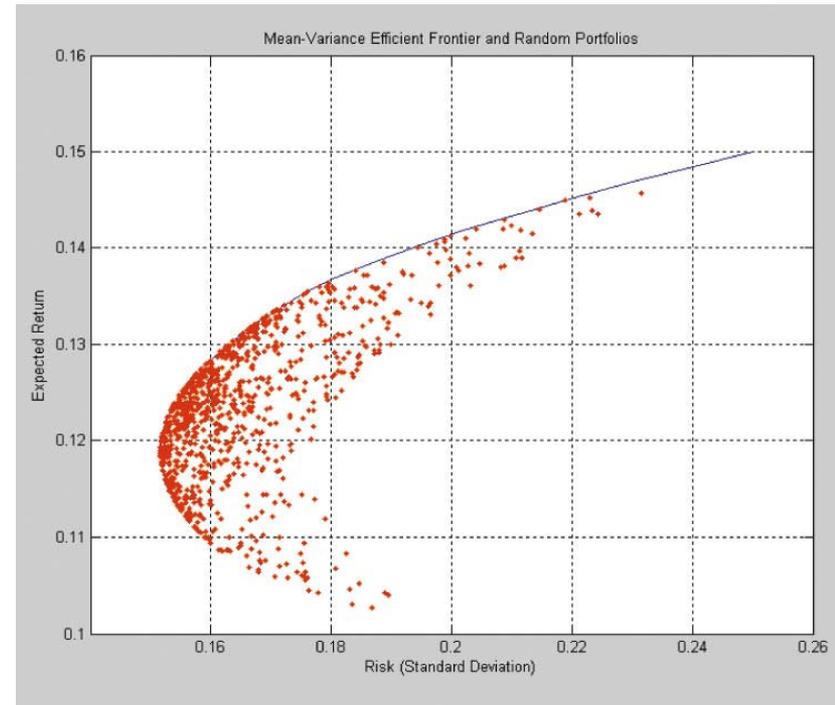
# U-CASS Research Methodology

- ***Understanding Economic Activity in Lower Manhattan:***
- The economic data gathered will feed into a “computable general equilibrium model” of the Lower Manhattan area.
- Will include key linkages between business in area and broader economy



# U-CASS Research Methodology

- ***Risk Modeling:***
  - Develop probabilities of different scenarios
  - Integrate risk and economic models to get estimates of risk and economic consequences
  - Seek ways to find “portfolios” of security initiatives that are “efficient” on variety of criteria



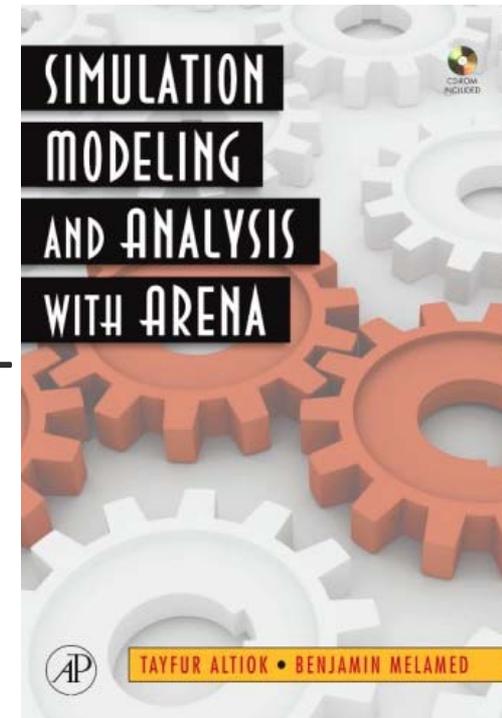


- ***Developing a Precision Information Environment (PIE):***
  - A decision support tool
  - A future work environment for emergency management
  - Uses extensive risk analysis and simulation capabilities, many developed by CCICADA researchers
  - Collaboration with PNNL's PIE project
  - Goal: usable by first responders, policy makers, and the public



# U-CASS Research Methodology

- ***Developing a Precision Information Environment (PIE):***
  - One version: based on ARENA simulation software
  - Another version based on OMNet++ simulation software





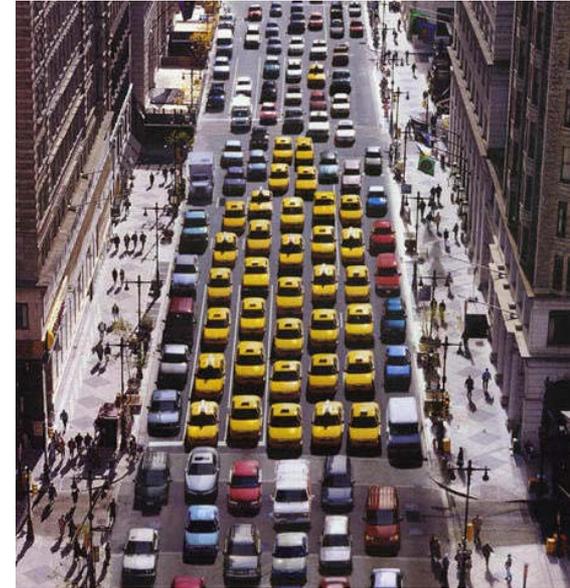
# U-CASS Research Methodology

- ***Developing a Precision Information Environment (PIE):***
- CCICADA has extensive experience with ARENA
  - But ARENA is not open-source; not usable over the web
  - OMNET++ can be used to create a web-enabled decision support tool.



# U-CASS Research Methodology

- ***Developing a Precision Information Environment (PIE):***
- ***Simulation tool: Using both ARENA and OMNet++:***
  - Tools for simulating movement of individual entities (workers, residents, shoppers, cars, taxis, buses)
  - Steps in developing the simulation:
    - Create problem scenario
    - Construct model logic
    - Verify model and create an animation
    - Experiment with model; validate it; compare outcomes



# Urban Commerce and Security Study (U-CASS)

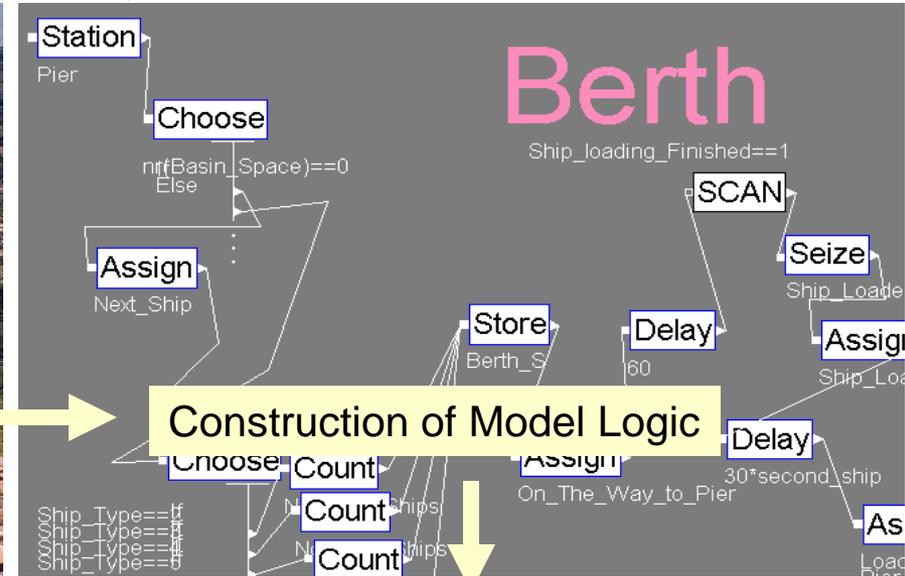


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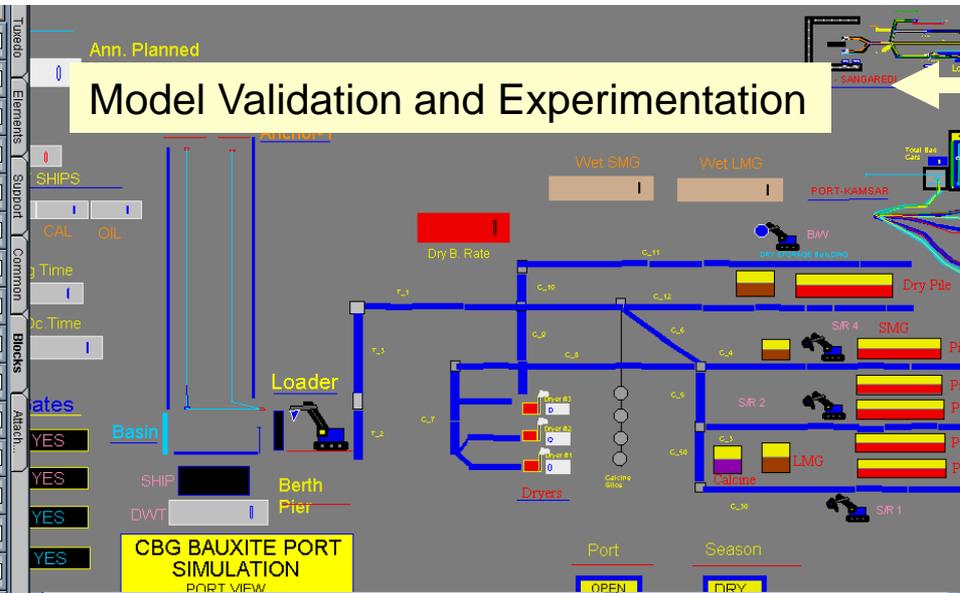
# Illustration of Simulation Modeling Process from Another Project: Simulation of Port Operations and Inspection; CBP



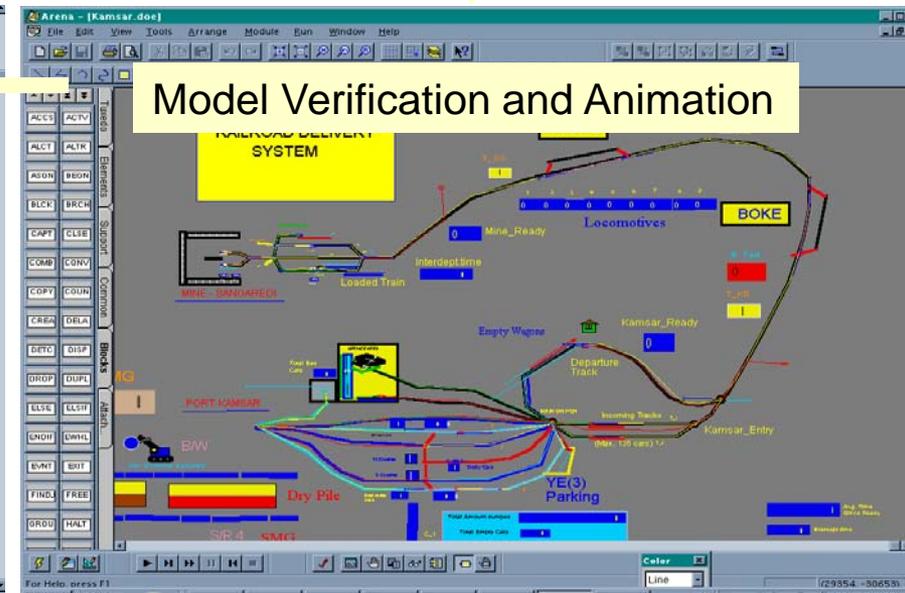
Problem Scenario



Construction of Model Logic



Model Validation and Experimentation



Model Verification and Animation

# Urban Commerce and Security Study (U-CASS)



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## Screen Shot of Simulation Tool for Street Grids & Traffic Movements in a DND0 nuclear detection project; using ARENA

JIMACS Urban Nuclear Detection

File Simulation Help

**Number of Streets:**  
Horizontal: 10  
Vertical: 11  
Block %: 20

**Car:**  
Color: Prob(Furn)  
Police: 30  Show  
Taxi: 15  Show  
Nuclear: 50  Show  
Criminal: 20  Show  
Stationary Nuclear: 1  Show

**Rotation Radius (Steps):**  
Police: 20  
Taxi: 15

**Detection:** PFP % PFN %  
Police: 10 10  
Taxi: 10 10  
Pos/Neg LH Ratio: 10  
Realtime Detection:  Disabled  
Manual Detection:  Disabled

**Simulation Parameter:**  
Steps per Sec: 20  
Steps per Hor/Block: 10  
Steps per Ver/Block: 10  
Steps per Display: 1  
Maximum Steps: 20

**Output:** From To  
Step: 2 50  
Folder: C:\Simulation\

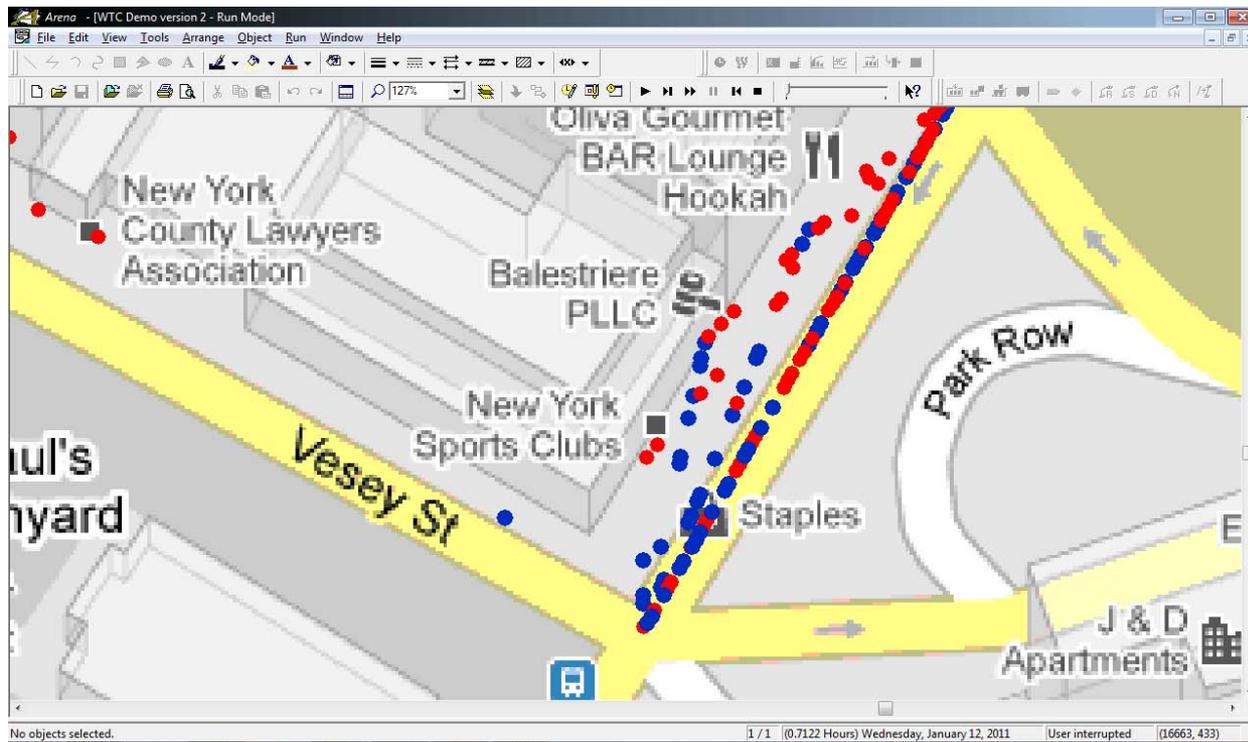
Stop **ARENA**

Step: 9



# U-CASS Research Methodology

- *Developing a Precision Information Environment (PIE):*
- *A snapshot from our WTC-area simulation:*





# U-CASS Research Methodology

- ***Developing a Precision Information Environment (PIE):***

- ***ARENA and OMNet++***

- ***Input:*** scenario and a security initiative

- ***Input:*** information about probabilities of different movements/behaviors

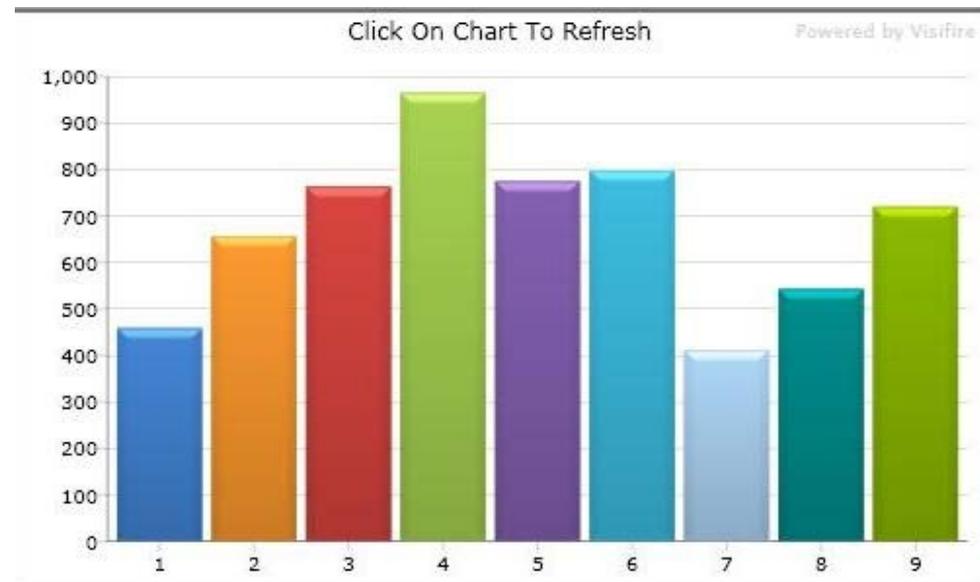
- If a pedestrian passes a restaurant, what is probability she will go inside?
- If a car finds a street blocked, what is probability it will make a right turn and seek a parallel street?





# U-CASS Research Methodology

- ***Developing a Precision Information Environment (PIE):***
- ***ARENA and OMNet++:***
  - ***Output:*** Changes in level of economic activity
    - After an hour
    - After a day
    - After a year





- ***Challenge 1: Not much relevant methodology***
- Project started with extensive survey of prior work on interplay between economic activity and security
- Significant literature on economic impacts of terrorist attacks
  - E.g., CREATE's work on economic impacts of Sept. 11 attacks on NYC, region, and nation (Blomberg & Rose, 2009)

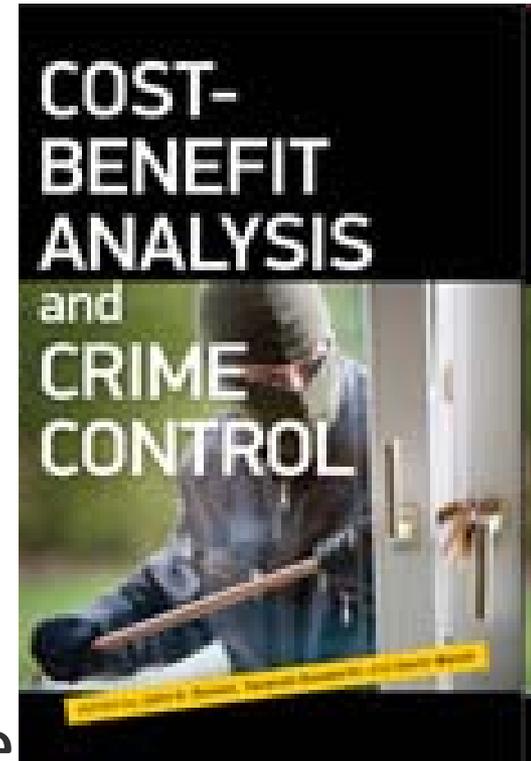




- ***Challenge 1: Not much relevant methodology***
- Considerably less work on economic impacts of security policies and practices
- ***Security Economics***: Activities that affect, prevent, or mitigate insecurity in the economy; use of tools to analyze dynamics of security



- ***Challenge 1: Not much relevant methodology***
- Methods of security economics include:
  - Cost-benefit analysis
  - “Impact analysis”
- But we have found that even in criminal justice, such methods are not used too often because of difficulties such as amount of uncertainty in relevant scenarios





- ***Challenge 2: Metrics***
  - How measure things like inconvenience, willingness to accept delays, etc.?





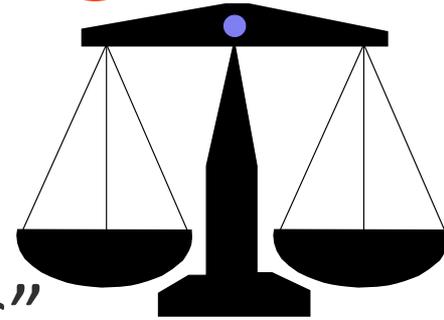
# Research Challenges

- **Challenge 2: Metrics**

- Many tools of economic modeling depend on “interval” or “ratio scales” whereas we may only be able to expect “ordinal scale” responses:

- Is this effect large, medium, or small?
- Is this green, blue, yellow, orange, or red?

- If we only have ordinal scales, can we use them in our economic modeling?





- ***Challenge 3: Infrequent Events***

- There is a considerable literature on economics and security when events have a reasonable frequency of occurring
- Then, recurrence of events allows for testing models and tools.
- Example: shoplifting





- **Challenge 3: Infrequent Events**
  - In the case of shoplifting:
    - Can readily compare investment in countermeasures against shoplifting vs. cost of not instituting those countermeasures



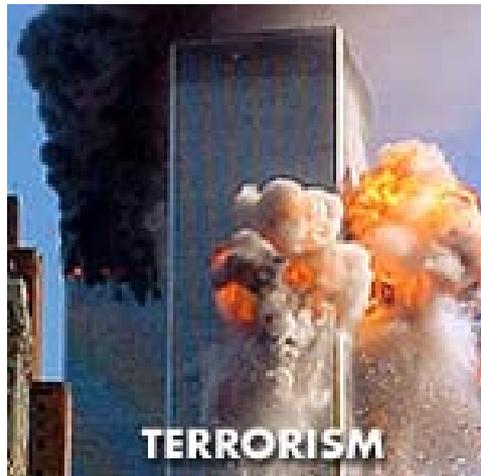


- ***Challenge 3: Infrequent Events:***
  - Insurance is another example
  - Investment in information technology for security is a third example
  - Beginning to be a literature on this topic





- **Challenge 3: Infrequent Events:**
  - In our application, we are dealing with relatively infrequent events.
  - Then, need totally new methods.
  - We don't have numerous repeated incidents (terrorism, earthquakes, etc.) to build on.





- ***Challenge 4: Data Uncertainty***

- Our analysis will deal with scenarios where there is minimal data to determine probabilities and other relevant parameters needed in simulation and risk assessment
- Conclusions will have considerable uncertainty.
- Will require extensive “sensitivity analysis” to develop any confidence in conclusions.





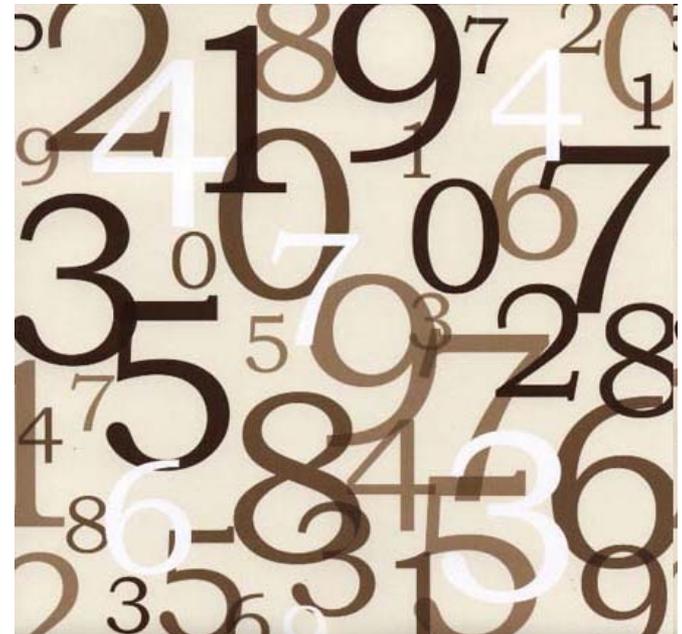
- ***Challenge 4: Data Uncertainty***

- Example: Put metal detector in store entrance
- How does this change probability a person will enter the store?
- Less likely because of long lines?
- More likely because it seems store is safer?
- Level of accuracy of these probabilities will affect conclusions about resulting economic activity.





- ***Challenge 5: Indirect Impacts:***
  - Both security initiatives and major events have both direct and indirect effects
  - These can be subtle and unexpected
  - And hard to quantify
  - CREATE is a pioneer in developing methods to estimate indirect impacts





- ***Challenge 5: Indirect Impacts:***
- Case in point: Economic impacts of closing off Pennsylvania Ave. in front of the White House (Hoffman, Chalk, Liston, Brennan, 2000)





- ***Challenge 5: Indirect Impacts:***
- Case in point: Economic impacts of closing off Pennsylvania Ave. in front of the White House (Hoffman, Chalk, Liston, Brennan, 2000):
  - Effects on local businesses due to disrupted traffic patterns
  - Reduced parking meter and parking ticket revenue
  - Increased costs of rerouting buses
  - Increased employee commuting time
  - Relocation of businesses leading to decreased property tax revenue and property values



- ***Challenge 6: Dependence on input from Individuals and Businesses***
  - Input often relatively subjective
  - Hard to quantify
  - Inconsistent responses
  - Subject to bias
  - Requires careful formulation of questions or you get the wrong information





- **Challenge 7: Measuring the Benefits of Security**
  - Most of the literature on economics and security has focused on ***costs of security***.
  - Virtually no work on ***benefits of security*** investments from economic point of view.
  - Difficulty of making benefits precise.
  - Differing time periods over which to assess benefits
  - Complexity of analyzing indirect benefits from security initiatives
  - ***Major challenge to U-CASS project: Develop methodologies for assessing economic benefits of new security initiatives***



- ***Challenge 8: Dangers of Paying Too Much Attention to our Numerical Results***
  - Our project aims to produce tools and methodologies
  - We will use estimates of basic parameters that could in fact be quite inaccurate
  - Still, use of such parameters will allow us to experiment with the methods and build the tools
  - We also hope to develop visually exciting demonstrations of our methods



- ***Challenge 8: Dangers of Paying Too Much Attention to our Numerical Results***
  - We have to guard against users paying more attention to our specific results than to the methods we develop
  - We hope our methods will be widely useful
  - ***However, the outcomes of our project will be the tools/methods, not the specific conclusions about economic impacts that come out of our simulations and demos***



# Comments on our Methodology

- Goal is to develop a widely-applicable methodology
- We aim to move from Lower Manhattan to other venues





# Comments on our Methodology

- Aim to provide planners and decision makers with a new methodology to analyze potential economic impact of security interventions
- Seek insights into when security acts as a barrier to economic activity and when it enhances such activity

# Urban Commerce and Security Study (U-CASS)



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*We look forward to continuing to work with numerous agencies in using our technical tools and expertise to enhance the security of Lower Manhattan and other urban areas across the US.*

