



Thoughts on Critical Infrastructure Collaboration

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New Threats



Especially since the events of 9-11, container shipments through US ports are believed to be a potential pathway for introduction of weapons of mass destruction (WMD) into the United States. Customs inspections were designed primarily to enforce tariffs and intercept illicit drugs and other contraband, and may not be well suited to interdicting WMD. New security measures have been implemented, and others proposed, in an effort to reduce this perceived threat.

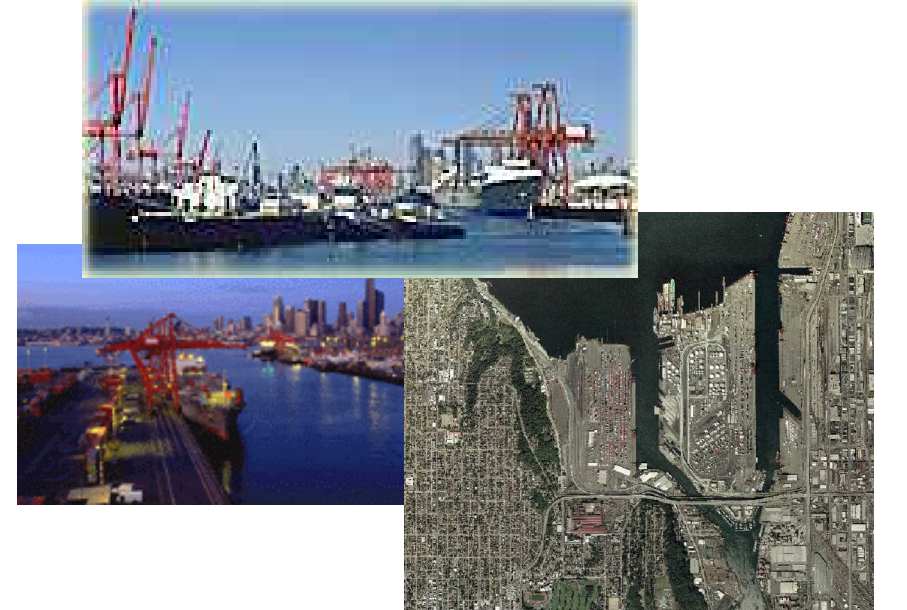
New Procedures

Requiring new security measures can change important performance characteristics of the port such as the time and cost required to import and export goods. These performance changes can suppress overall demand for shipping, and change the relative attractiveness of ports to importers, exporters, and cargo carriers.

New Costs

Effective security measures must take account of the economic consequences they entail. The National Strategy for the Protection of Critical Infrastructures and Key Assets (2003) issued by the White House states that "security solutions to the container shipping challenge should recognize that, in many cases, commerce, including essential national security materials, must continue to flow...Stifling commerce to meet security needs simply swaps one consequence of a security threat for another." Successful port operations requires the coordinated action of many disparate people and organizations, including ship owners, port authorities, importers and exporters, labor unions, and government agencies. Negotiating the appropriate balance between security and cost requires considering the consequences of alternatives on these diverse interests.

New Economic Challenges



To help define and explore the tradeoffs between security and commerce, we have used simulations to engage diverse representatives of business and government. In collaboration with domain experts, we have developed models of port performance on two relevant time scales. A short-term port operations model simulates the effects of a variety of security measures on port operations in terms of shipping cost and delivery time. A long-term port economics model simulates the possible consequences of port performance changes caused by security measures on the long-term competitiveness of the port. In workshops designed around these models, we have engaged government and business representatives in discussions about the ramifications of security policies. These workshops have catalyzed discussions among the diverse parties concerned with ensuring secure and efficient shipping.

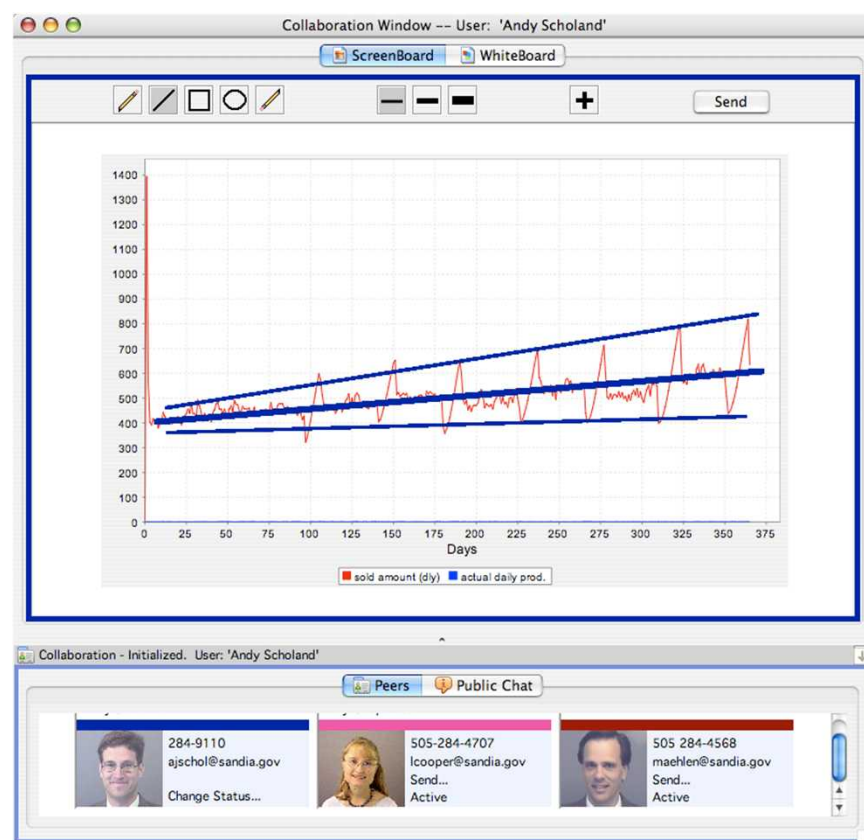
Focus on Collaboration

The vision for NISAC is to address the domain knowledge problem by building collaborative ventures with this diverse group of public and private entities, amalgamating widely geographically and organizationally distributed infrastructure expertise.

Synchronous collaboration is needed both to obtain a critical mass of knowledge (participation, particularly by experts) and to initiate dynamic growth (brainstorming, hypothesis formation and refutation) focused on a particular problem of interest.

Asynchronous access enriches and enhances the artifacts of synchronous collaboration.

- Contextual Requirements: who, when, and why interactions occur
 - Who: associate educational background, disciplinary viewpoint, experience, organizational affiliation of contributors to specific points of discussion
 - When: calendar time, phase of analysis, relation to new information arrival
 - Why: raise or answer domain questions, create consensus decisions, classes of simulation behaviors, ...
- Semantic Requirements: identifying what interactions occur around
 - What areas do experts drill into?
 - What data do they use to verify simulation results match their experience? Are there common attributes? Do these match any of the known 'who' 'when' or 'why' dimensions?
 - Frequently Observed Objects (FOOs)



Open research questions include:

What prior art needs to be embedded in the framework to maximize the quality of deliverables from collaboration?

- Identifying relevant prior art (small group dynamics, student models, ...)
- Implementing it appropriately, given typical problem constraints
- An effective strategy for homeland security:

How can automated algorithms answer the kinds of questions that determine validity?

What features are needed to drive adoption over existing methods? How should they be presented to potential users?

How can information be customized (abstracted, filtered, presented) in a generic enough fashion to meet the needs of a broad array of information consumers, not just analysts?

Once formerly transitory and ephemeral exchanges between researchers and stakeholders are captured, what do we do with the information?

Port Operations

Our first goal was to explore the tradeoffs between security and port performance by evaluating performance under a variety of alternative security policies. We designed a short-term simulator of port operations to help us assess port performance under imposition of diverse security policies. There are many possible security policies, each some subset of:

Increased manual inspections

Port of departure inspections

Cargo profiling

- Early manifest reporting
- Supply chain assurance (e.g., C-TPAT)

Container seals

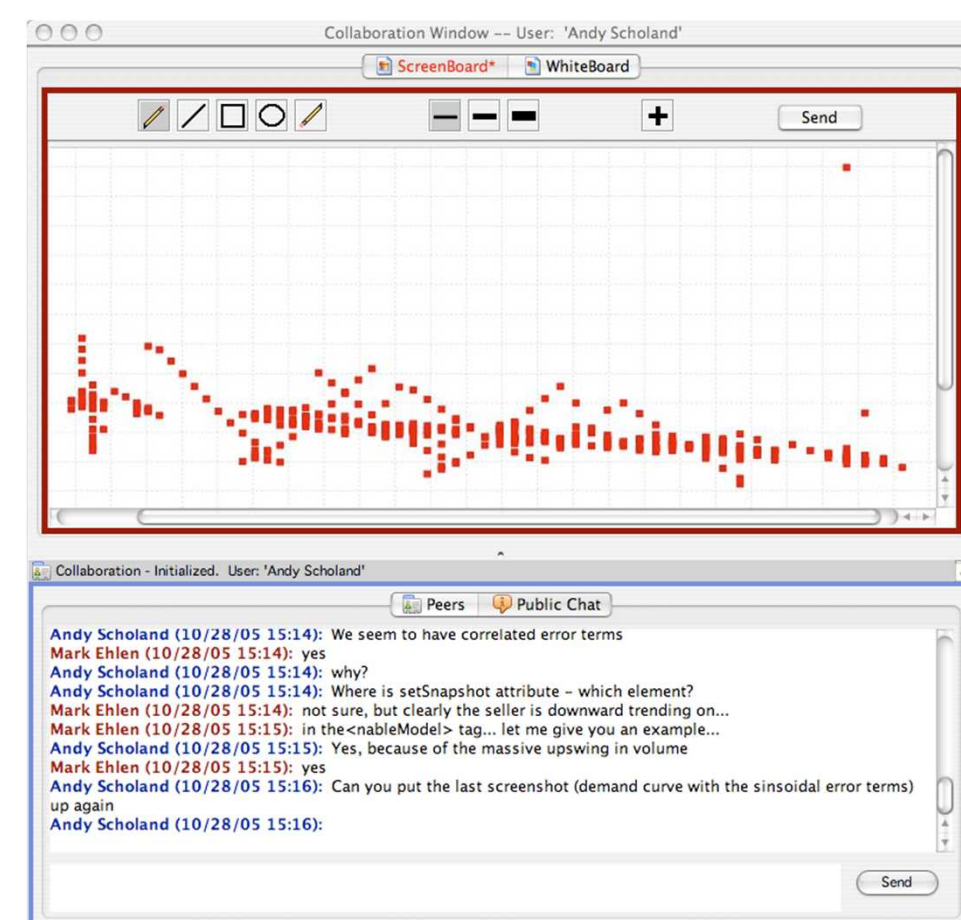
- Physical
- Electronic/smart
- Seals for empties

Scanners

- Radiological
- Chem/bio

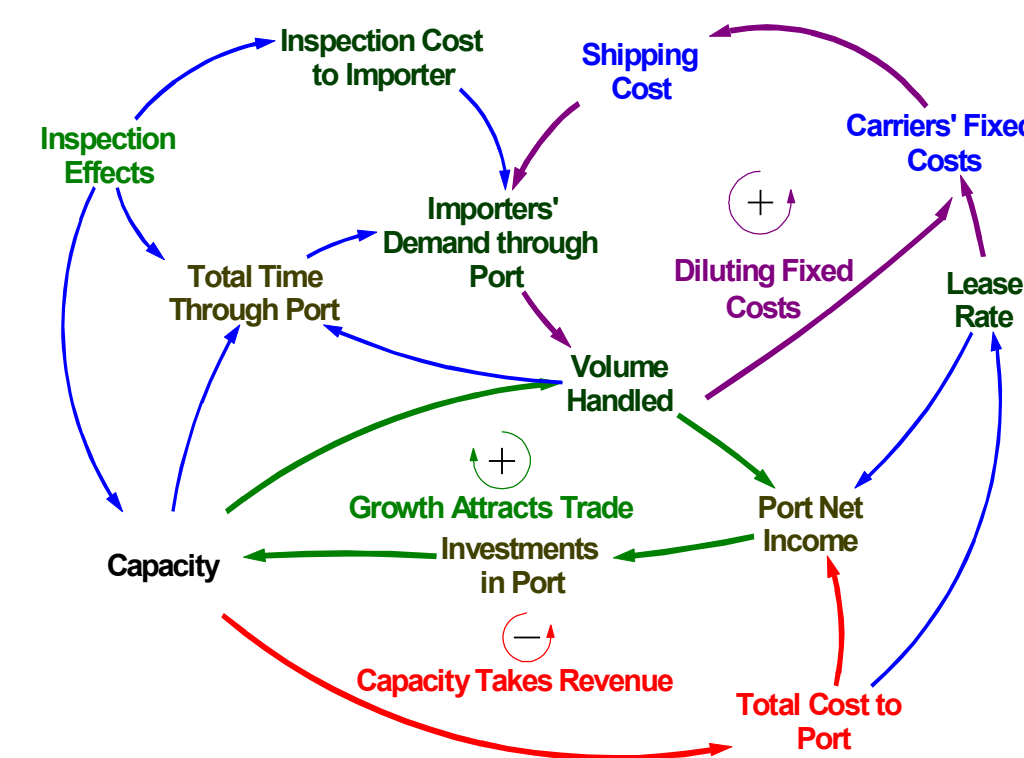


Each policy has some associated performance characteristics. One port operations model was designed to evaluate the effects of security measures on shipping cost and delay, to provide an understanding the robustness of port to disruptions under different conditions, and of the ability of the port to recover from such disruptions. A collaborative environment would have enabled modelers to enlist domain experts in identifying spurious results.



Port Economics

Ports have large fixed costs for facilities and equipment, and may have large recurring maintenance costs (e.g. for dredging) that do not vary with port traffic. In the long term, the greater the traffic through the port the lower the unit cost. Large traffic volume may allow Ports to lower the rates they charge to carriers, which make the port more attractive, and thereby attracts more trade. Conversely, a decrease in traffic can increase the unit cost, making the port less attractive, and diminishing trade. Long-term port operations exhibit other classical feedbacks: higher traffic volume increases income and permits more investment in equipment and facilities, allowing even higher traffic; repair and maintenance of existing capacity diminishes income and hinders capacity expansion.



The relationships among the factors influencing the long-term economic viability of the port are reflected in a causal loop diagram. The long-term model implements these relationships, and allows the user the adjust the parameters that define them.

We have focused on the long-term economic viability of the port. There are several distinct interests that must be served by the port in order to remain competitive, including carriers, importers and exporters, and local businesses that support or rely upon port operations. Some key decision variables in our analysis include:

- Costs to carriers of making a port call
- Costs to importers of customs inspections and supplementary security measures
- Delays and unpredictability in shipping time created by alternative security measures
- Lease rates and other fees charged by the Port
- Long-term performance will clearly depend on external factors as well. Our analysis allows alternative assumptions for interest rates and market growth.

Working with Industry

We have consulted with port operations specialists, port interests, and business representatives to learn about port operations and to vet our models. We have worked with numerous individuals to design and parameterize the port models and structure analyses. Collaborators and domain experts that helped us develop the model and workshops included:

- Pacific Northwest Economic Region
- Regional Maritime Security Coalition
- US Coast Guard
- Bonneville Power
- Ports of Seattle and Portland
- Cities of Seattle and Portland
- University of Washington
- Lucent Technologies
- Transportation Strategies International



We conducted 1/2 day workshops in both Portland and Seattle designed around these models to engage government and business representatives in discussions about the ramifications of security policies. These workshops catalyzed discussions among the diverse parties concerned with insuring secure and efficient shipping. During the workshop, representatives from industry (including labor) and government (including the newly formed Department of Homeland Security) used the models to:

- Run through short-term model base case together
- Run a disruption scenario, which included attempting to anticipate disruption effects and trying to mitigate them
- Examine the effects of security policy options, including both single technologies or procedures, and combinations of security elements
- Explore the effects of security policies on economic viability using the long term model. This entailed examining a base case to understand and manage long-term behavior, then examine the consequences of imposing a security policy with costs and delays estimated from short term model

One group at the Portland workshop demonstrated that by imposing higher scanning and inspection rates dynamically and intermittently in response to high alerts and certain seasonal periods (such as before the July 4th holiday when imports of fireworks skyrocket) that the overall perception of security could be enhanced while minimizing inspection backlogs.