Systems Based Vulnerability & Risk Assessment

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Risk Assessment

- An analytical process to provide information regarding undesirable events
- The process of quantification of the probabilities and expected consequences for identified risks

Vulnerability Assessment

- Systematic approach used to analyze the effectiveness of the overall (current or proposed) defense system

Systems Based Risk Assessment

- Well developed in some areas (e.g., engineering and IT)
- Often requires high skill users
- Most approaches assess the risk within a component or physical asset of a system, not across systems
- Interdependencies often difficult to capture

National Preparedness Goal

"(Develop) measurable readiness targets …that appropriately balance the potential threat and magnitude of terrorist attacks, major disasters, and other emergencies with the resources required to prevent, respond to, and recover from them"

Vulnerability/Risk Assessment to Support the NIPP

- Identify the most important areas within and across critical infrastructures to:
  - Identify greatest potential for catastrophic impact if attacked
  - Focus limited public sector resources to reduce risk and vulnerability
  - Focus limited private sector resources to reduce risk and vulnerability

Risk Assessment Tool Requirements

- Sufficiently user friendly
- Scalable from lowest level of evaluation up through to national impact
- Enables identification and prioritization of a limited number of areas for focus

Unique Challenges for Homeland Security Use

- Comparable, relative risk rankings required across all infrastructures
  - Asset only
  - Asset based, localized impacts
  - Asset based, system implications
  - System based, asset vulnerabilities
  - System only
- Tool bias could bias resource allocations
- Psychological implications hard to estimate

Food & Agriculture Infrastructure

- The most complicated supply chain in existence
  - Globally dispersed
  - Privately held
  - Highly integrated
  - Flexible
  - Dynamic
- Innumerable potential points of disruption/contamination
- Inherently systems based, not asset based

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2.1 Million
U.S. Farms

30,000 U.S.
Processing Sites

94,000 Foreign
Processing Sites

? Million
Foreign Farms

19,000 Domestic
Packers/Repackers

87,000 Foreign
Packers/Repackers

224,000 Retail
Food Stores

935,000 Retail
Food Outlets

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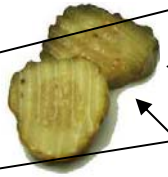
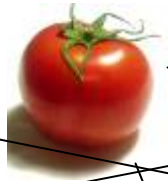
Supply Chain Complexity

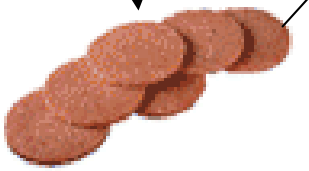










PRIMARY PRODUCTION ➤ HARVEST ➤ TRANSPORTATION ➤ STORAGE ➤ PROCESSING ➤ DISTRIBUTION ➤ RETAIL/FOOD SERVICE ➤ CONSUMER

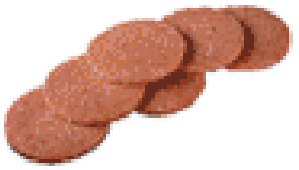
Supply Chain Complexity

One Burger Contains:

bleached wheat flour
malted barley flour
thiamine
riboflavin
Niacin
folic acid
reduced iron
Water
corn syrup
sesame seeds
soybean oil
Yeast
Salt
calcium sulfate
calcium carbonate
calcium silicate
soy flour

baking soda
wheat gluten
calcium propionate
enzymes
mono- and diglycerides
diacetyl tartaric acid esters
ethanol
sorbitol
polysorbate 20
potassium propionate
sodium stearoyl lactylate
corn starch
ammonium chloride
ammonium sulfate
calcium peroxide
ascorbic acid
azodicarbonamide

Milk
Water
sodium citrate
sodium phosphate
artificial color
acetic acid
Enzymes
milkfat
cream
salt
sorbic acid
cheese culture
soy lecithin
starch



USDA inspected beef

<u>Special Sauce</u>
Soybean oil
distilled vinegar
egg yolks
sugar
corn syrup
spice extractives
xanthan gum
prop. glycol alginate
potassium sorbate
garlic powder
caramel color
Turmeric
EDTA
pickles
water
HF corn syrup
onion powder
spice
salt
mustard flour
sodium benzoate
mustard bran
hydrolyzed proteins
paprika
calcium disodium

Cucumbers
water
Vinegar
Salt
calcium chloride
Alum
natural flavorings
polysorbate 80
turmeric

lettuce

dehydrated onions

<u>Grill Seasoning</u>
Salt
Pepper
cottonseed oil
soybean oil

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Agriculture Attack Impacts

- Primarily an economic threat with major confidence in government impact
- Nationally distributed target with global trade significance
  - Local through national economic dislocations with rapid onset and slow recovery
- Cascading economic, psychological & sociological effects
  - UK and Dutch FMD outbreaks registered significant post-traumatic stress disorder rates

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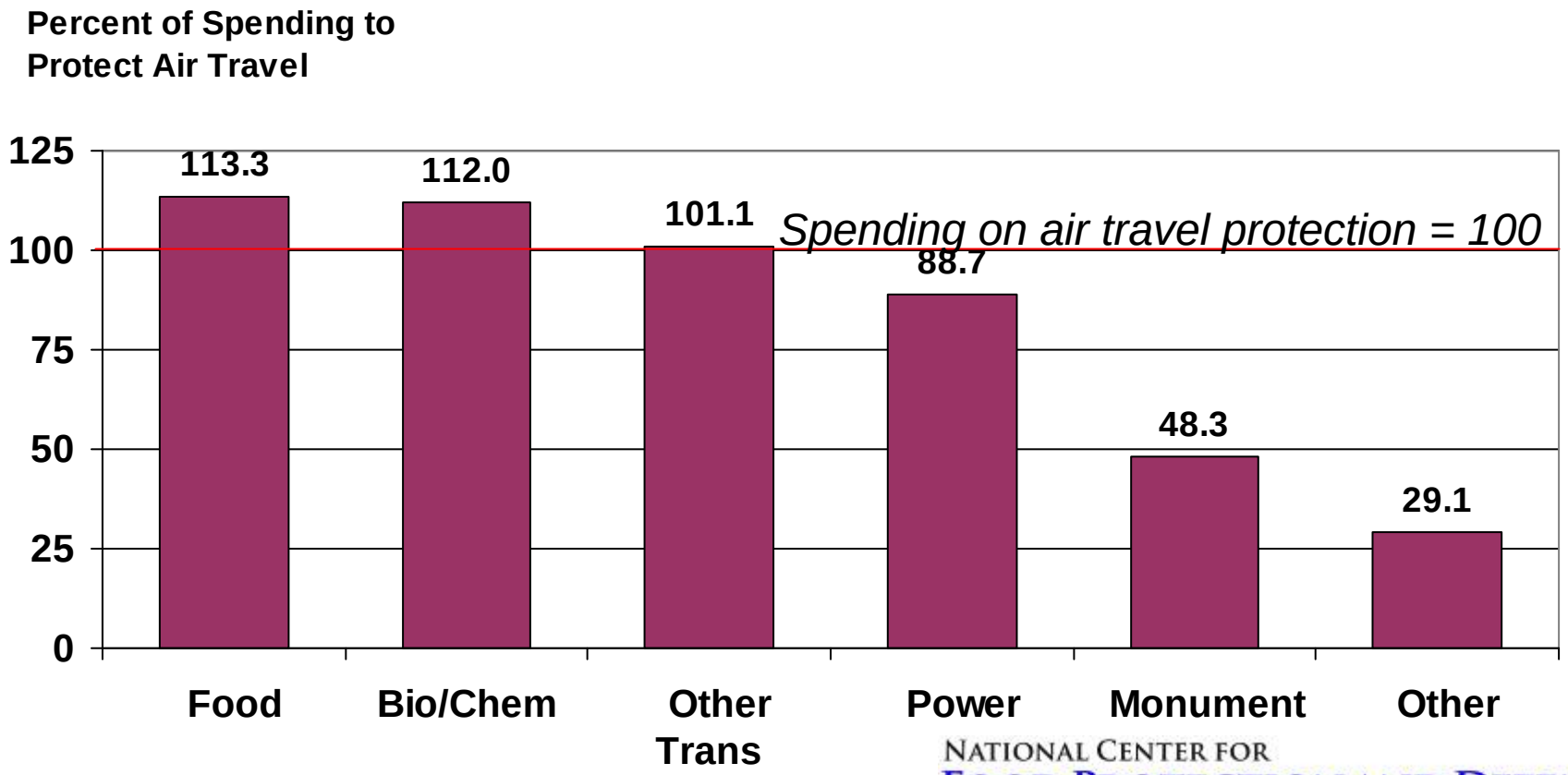
Food Attack Impacts

- Both a significant public health and economic threat
  - Access to sufficient calories not a likely issue in developed nations, could be one in poorer nations.
- Globally distributed target
- Psychological impact of personal threat vector for delivery of agents
  - "Will my cookie kill me" – as a Weapon of Mass Destruction threat

Consumer Perceptions

- Consumers believe terrorism events will occur in the near term
- Food attacks are the least anticipated, but consumers would spend the most on preventing
- Consumers place burden on the government first, industry a close second, for food defense

Public Would Spend More for Food Defense and to Prevent Chemical-Biological Attacks



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Current Tools – ORM

- Operational Risk Management (ORM)
  - NASA/DoD engineering approach to reduce risk of failure of complex systems
  - Utilized by FDA in early assessments
  - Risk a function of severity & probability
  - Very effective at reducing risk within an operation or system
  - Results not readily comparable across operations or systems

ORM Ranking Grid

		Probability				
		Very High	High	Medium	Low	Very Low
Severity	Very High					
	High					
	Medium					
	Low					
		RISK LEVELS				

Current Tools – CARVER+Shock

- CARVER+Shock
  - DoD approach for targeting assets for greatest impact
  - Within an operation or system, used to identify the nodes of greatest concern
  - Results not readily comparable across operations or systems
  - Currently used by FDA & USDA

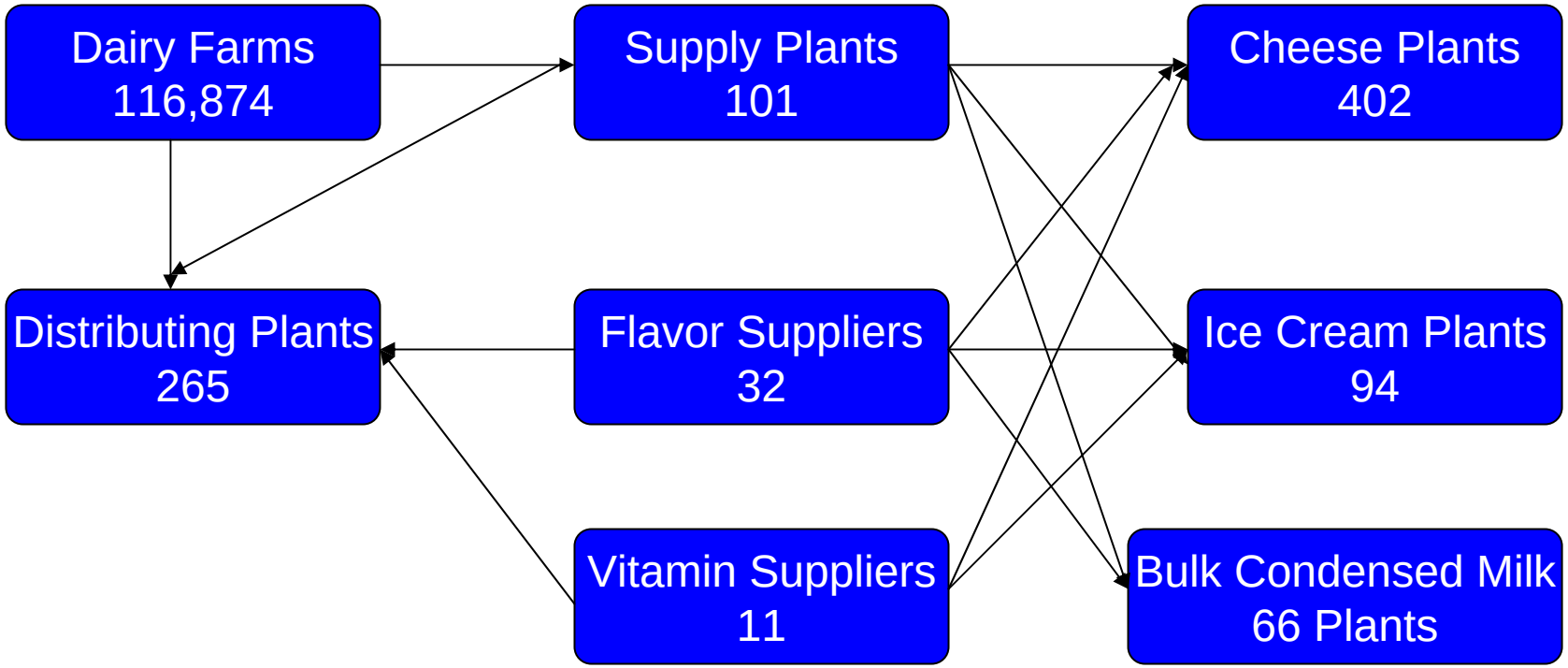
CARVER + Shock

- CRITICALITY: public health & economic impact
- ACCESSABILITY: target physical access
- RECUPERABILITY: overall system resiliency
- VULNERABILITY: attack feasibility
- EFFECT: direct loss from attack
- RECOGNIZABILITY: ease of target identification
- SHOCK: psychological implications of the attack

Systems vs. Assets Approach

- Asset based approach assumes limited number of fixed, vulnerable assets for deploying “guns, gates & guards” interventions
- Systems based approach assumes systems, and cascading interdependent systems, that require more than “guns, gates & guards”

~117,750 Primary Dairy Facilities



Intentional contamination of ***ONE BATCH*** at any one of these points could result in catastrophic public health and economic harm

Current Research Approach

- Characterize food/animal systems for assessment
- Develop approaches for assessing criticality
- Define a suite of existing risk/vulnerability assessment tools for evaluation
- Apply the tools to the model systems
- Modify a limited set of tools for piloting with end users

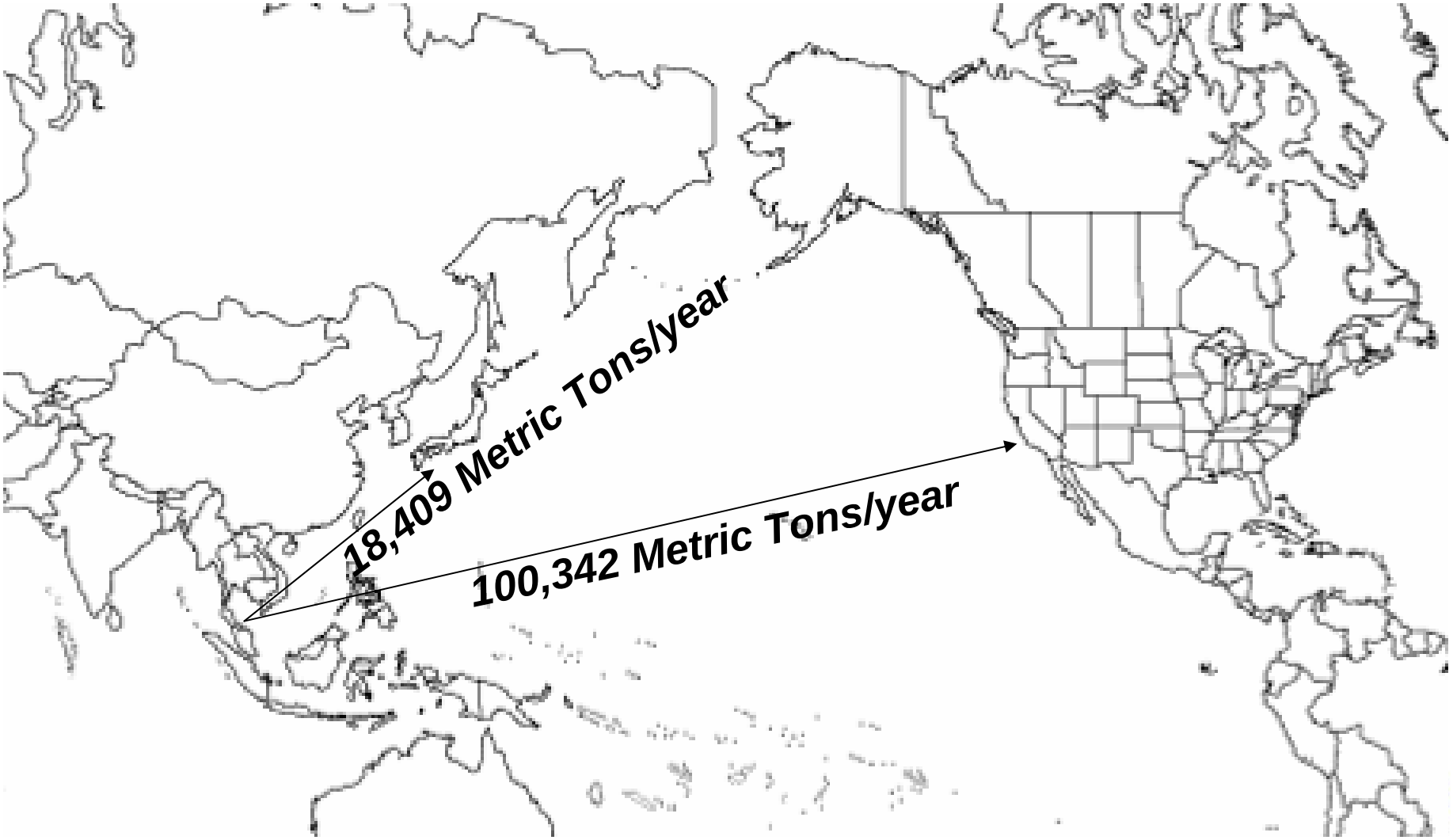
Characterize Food / Animal Systems

- Develop a set of well characterized example food and agriculture systems
  - Domestic food system
  - Imported food component, domestic system
  - Imported food system
  - Domestic production animal system
  - Imported live production animal system

Food System: Imported Shrimp

- Majority of shrimp for the U.S. is imported
- International sources serve multiple regions
- Intentional contamination overseas might or might not be intended for the U.S.

Thailand Shrimp Exports



Early Observations

- Allowing two different types of “terrorists” improves tool utility (insider and stealth outsider):
  - “Insider” only does not provide enough discrimination
  - “Stealth Outsider” only does not recognize ease of insider penetration in some systems

Early Observations

- Hoax or threat inclusion shifts relative economic vulnerability/risk results
  - Time to definitively refute a hoax or threat without existing interventions too long for some scenarios
  - Certain food & agriculture systems are more susceptible to the negative consequences of potential public/stakeholder reaction to a hoax or threat

Next Steps

- Further develop and pilot criticality tools with stakeholders
- Complete test food and production animal system characterizations
- Multi-state/stakeholder trials of criticality and vulnerability/risk assessment tools

Next Steps

- Revise criticality tools and utilization guide for 2008 DHS Data Call
- Apply revised assessment tool set to all test systems
- Transition final tool set to lead user groups for beta testing and refinement

“Defending the safety of the food system through research and education”

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