

Department of Homeland Security Science & Technology

How Technology Can Address Homeland Security Challenges:

Ecosystem of Innovation

September 28, 2012



Homeland
Security

How Can We Build a Culture of Innovation in S&T?

- A. How can S&T attract, retain and nurture top caliber staff from diverse disciplines?**
 - 1. How do we attract the best scientists and engineers into government service?**
 - 2. How do we keep S&T staff technically up-to-date, conversant with cutting edge developments?**
 - 3. How do we develop and protect time to think and learn within the federal bureaucracy?**
- B. How do we build a learning organization and encourage multi-disciplinary, team-based approaches?**
- C. How do we encourage risk-taking and reward success in times of budget constraints?**
- D. How do we capture, share and use the knowledge we have and lessons learned?**
- E. How do we balance short-term R&D focus vs. strategic vision of transformational possibilities?**

Historical Record: How Scientific Revolutions Happen

Not just about discovery

1. **Something in the air – willingness to think anew; 18th century Enlightenment rationalism**
2. **Human networks – letters, coffee houses, Royal Society, French Academie Science, trade networks**
3. **New instruments, more widely available**
4. **Prosperity – time to think, experiment**
5. **Population – critical density willing to share information and failures**
6. **Domain shifts in application of technologies**

What is Technology?

“All technologies harness and exploit some phenomenon or effect (usually several) to human purposes.”

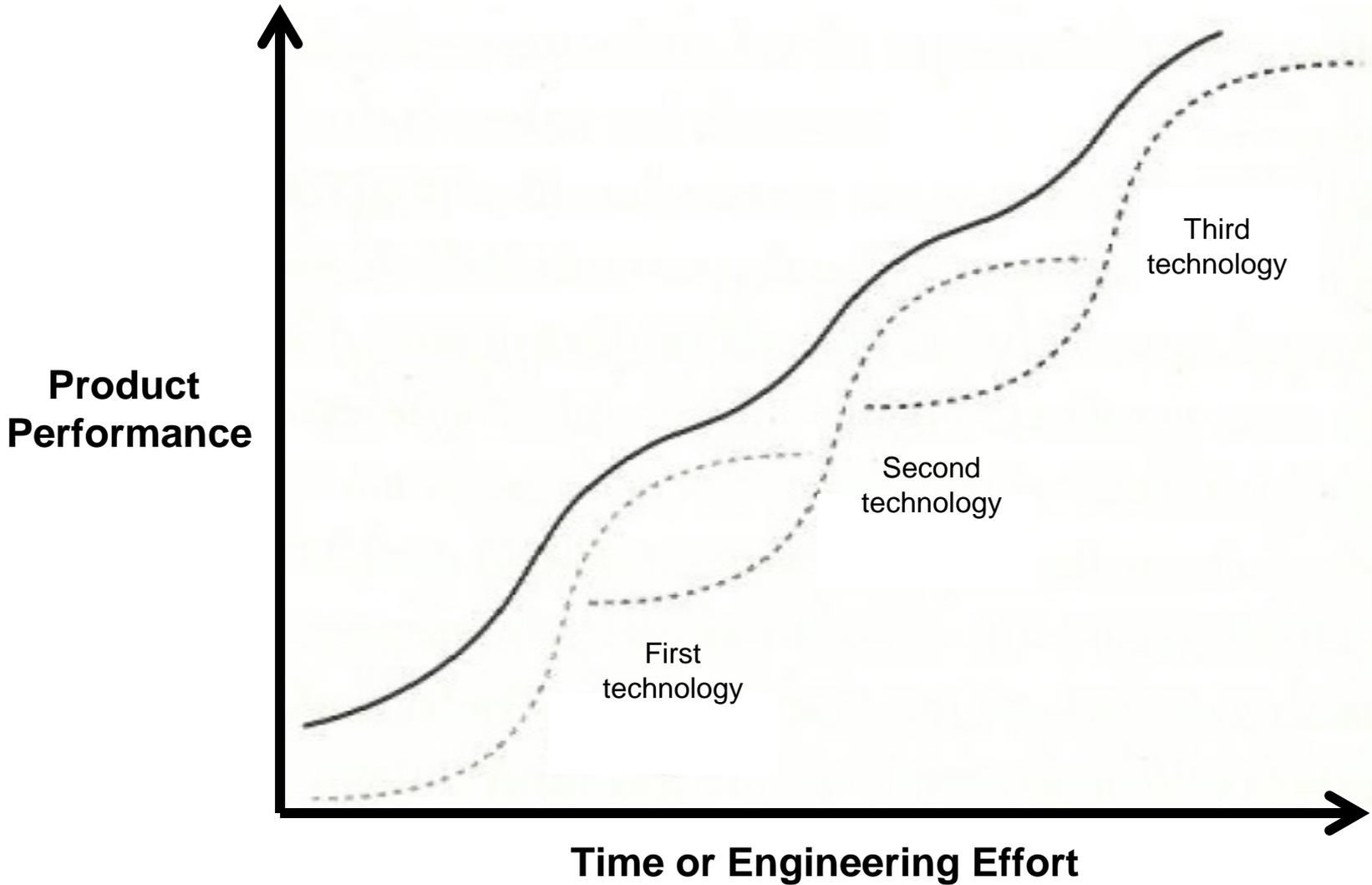
–W. Brian Arthur, *The Nature of Technology*, 2009

Technology: Three Themes

- 1. All technologies are combinations**
- 2. Each component is itself a miniature technology**
- 3. All technologies capture and exploit some natural phenomena, usually several**

“Technology builds out not just from the combination of what already exists, but from constant capturing and harnessing of natural phenomena.”

Compound S-Curves



Where Innovation Comes From

- ❑ **Arthur:** “In the cases I have studied, again and again I am struck that innovation emerges when people are faced by problems – particular, well-specified problems.”

- ❑ **Kelly:** “When web of supporting technical species are in place, an event will erupt such that many people will have same idea at once. This is the Technium’s imperative.”

Inverted Period of Invention

<u>Inventors</u>	<u>Stage</u>	<u>Task</u>	<u>Example</u>
10,000-1,000	Think of Possibility	Recognizing an opportunity for solutions	We should use electricity for lighting
1,000	Idea of How	Imagining the crucial elements of the solutions	An incandescent wire in a sealed bulb!
100	Details Specified	Selecting specific solutions	Welded tungsten, vacuum pump, solder exhaust port
10	Working Device	Proving your solutions work reliably	Prototypes by Swan, Latimer, Edison, Davy, etc
1	Enabling Adoption	Convincing the world to adopt your solutions	Edison's bulb (and electric system)

Innovation Advantages at S&T

“Top heavy bureaucracies remain innovation sink holes.”

–Steven Johnson, *Where Good Ideas Come From*, 2010

- Compelling missions, problem rich environment**
- Capacity to leverage investments by others**
- Opportunities for test beds, pilots**
- Capacity to partner with private sector, universities, other federal agencies and other countries**
- Convening power of government**

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How Technology Can Address Homeland Security Challenges:

Emerging Threats

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Emerging Threats Questions

- What are the most critical challenges, constraints, and opportunities presented by science & technology in the next 5-10 years?**

- How can S&T best position itself to assist the HSE with emerging threats?**

- How can S&T promote a proactive approach to threats within DHS instead of a reactive approach?**

- Is it possible to position for emerging threats when operational partners are only concerned on existing threats?**

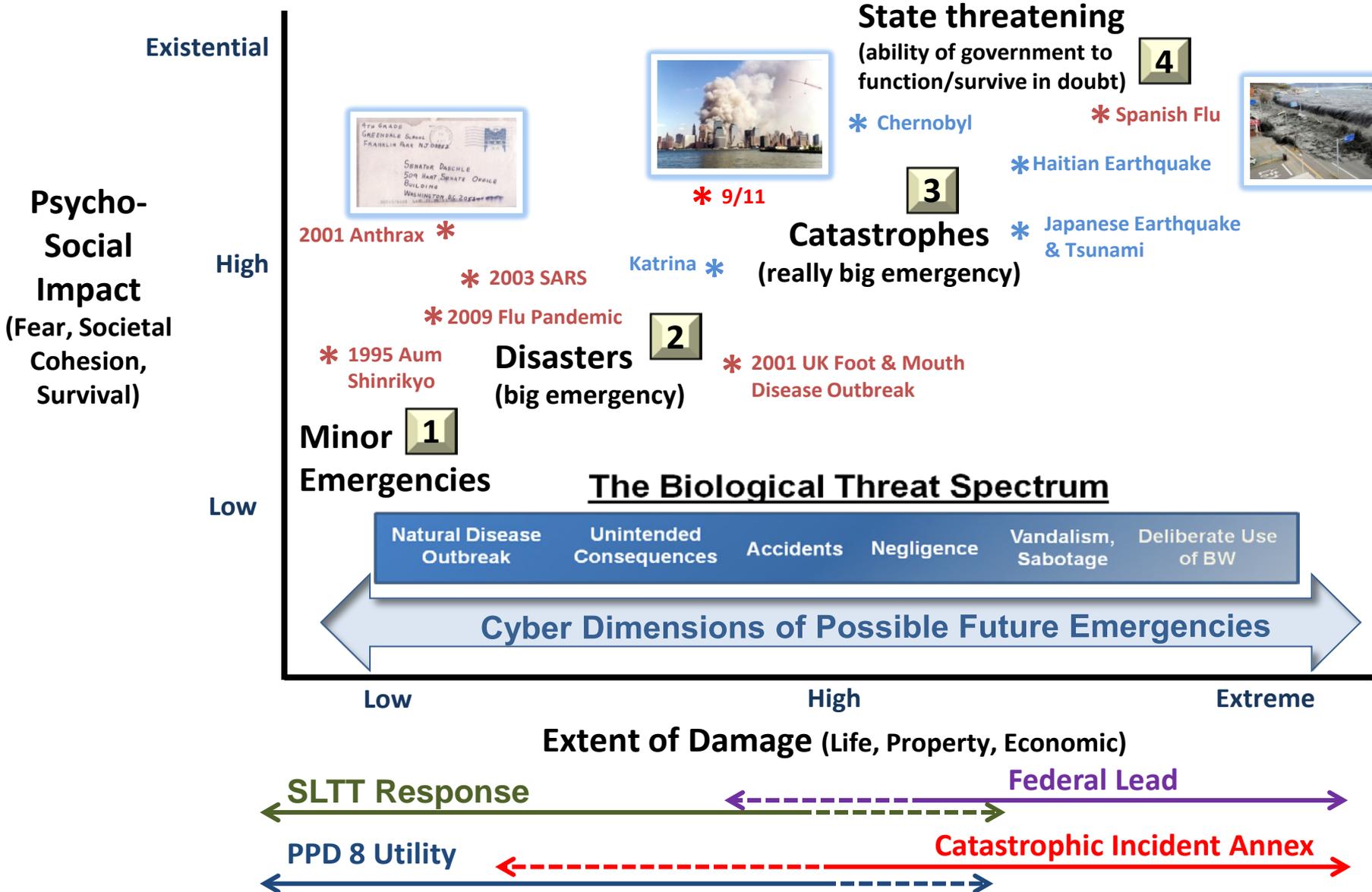
Environment: Greater Use of Technology, More Threats, Less Resources



LESS RESOURCES

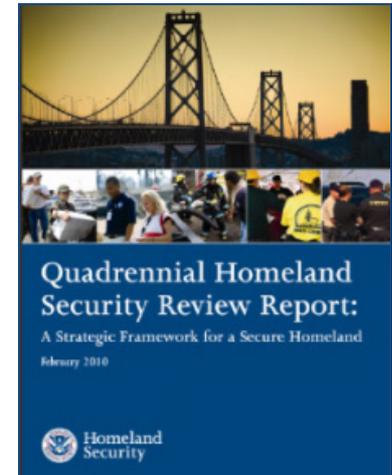
MORE THREATS

Dimensions of Emergencies



QHSR -- Bottom Line Up Front

- ❑ S&T was under-represented in QHSR 2010
- ❑ QHSR 2013 provides an opportunity to showcase the value and impact of technology on the HSE
 - Challenges, Threats, Risks
 - Constraints
 - Opportunities
- ❑ QHSR 2013 provides an opportunity to pave the way to the future and look at the how of the mission
 - How does the HSE approach the most important things?
 - How the Department & S&T are organized ...



DHS Executive Steering Committee

- Alice Hill/Alan Cohn chair
- Reps from components (S&T Rep: Deputy U/S)
- So far listed most significant trends
 - Challenges
 - Constraints
 - Opportunities
- Next steps:
 - Define capabilities needed
 - Resource type between comp.
 - Develop common metrics
 - Define success

Technology is key in all categories

S&T Executive Steering Committee

- Deputy U/S Gerstein chairs
 - Reps from groups (Deputies), CKO, SPO
 - Crafting tech foraging queries
- Next steps:
 - Meet regularly with team and the S&T leadership group
 - Examine role of technology within the HSE missions
- Goal:
 - Serve as a though leader within the Department

Top Trends for QHSR 2013: Per DHS ESC

Consolidation of Global Supply Chain

Data Privacy & Security

Increased Role of Non-State Actors

Non-State Actors Filling Void in Weaker States

Increased Use of Connected Technology by Individuals

New Centers of Global & Regional Influence

Increased Digitization & Transmission of Data

Increased Extreme Weather

Decay of U.S. Infrastructure

Regulation Following Crises

Narrowing Global Digital Divide

Distribution of Global Political, Economic, and Military Power

Individual Access to Highly Advanced & Specialized Technology

New Ways for Gov't & People to Work Together

Business and Gov't Dependent on Shared Information

Increased Reliance on Mobile Connected Technology Across Society

Nuclear Proliferation

Rising Demand for Resources - Food, Water, Energy

Increased International Migration

Economic Growth in Developing Countries

Federal Grants Comprise Significant Portions of SLTT Budgets

Growth & Increased Efficiency of Global Supply Chain

Increased Reach of Global Disease

Financial Crisis & Global Debt

Constrained SLTT Budgets

Increased Transnational Criminal Activity

Legend:

- Three categories considered -- Challenges, Constraints, Opportunities
- Ratings: **Green** = 3/3 in the top ten, **Blue** = 2/3 in the top ten, **Red** = 1/3 in the top ten
- Font size = number of votes

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How Technology Can Address Homeland Security Challenges:

Big Data

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Big Data Questions

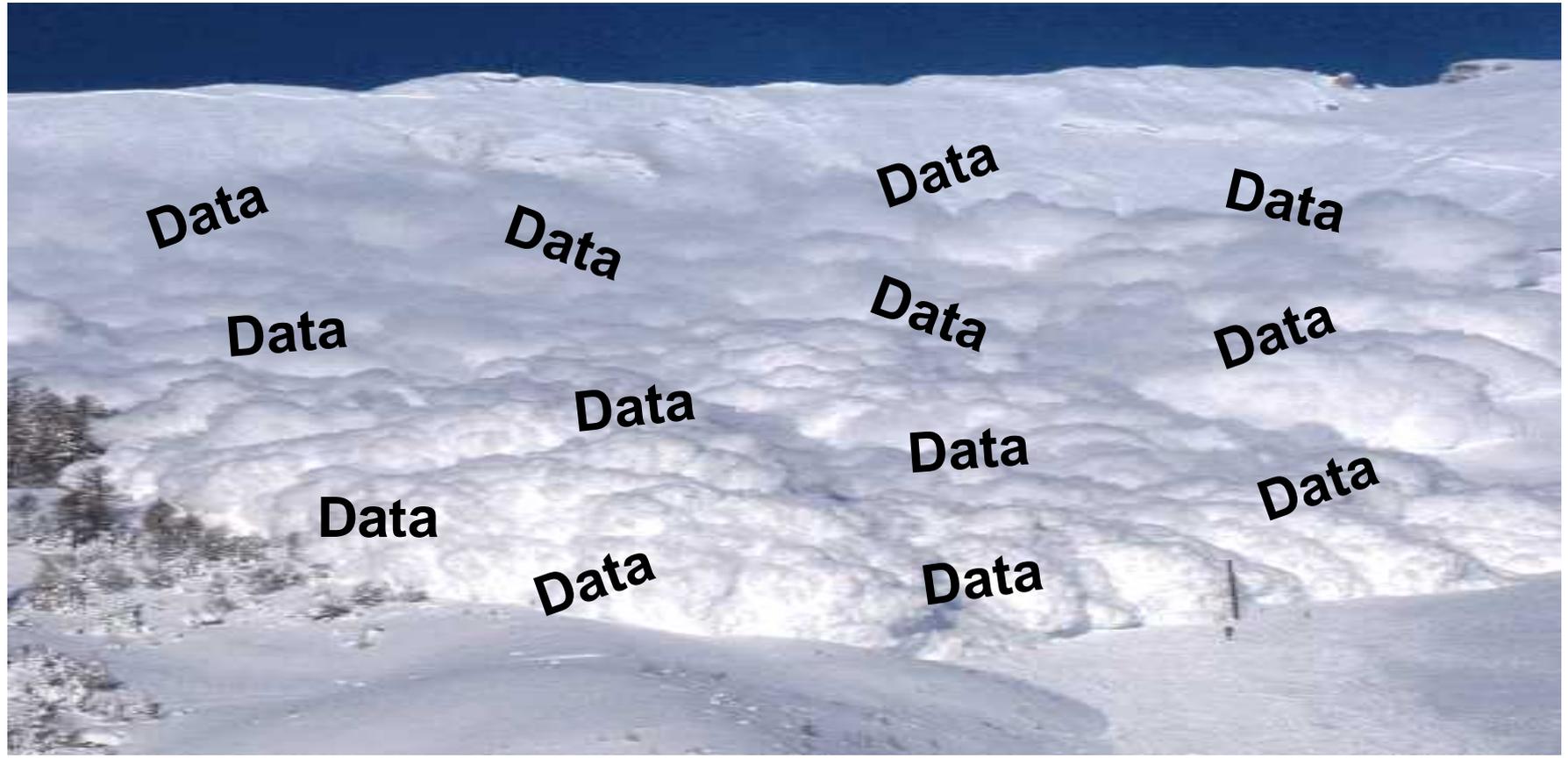
- What are the elements of the Big Data issue?**

- What are the challenges, constraints, and opportunities presented by Big Data?**

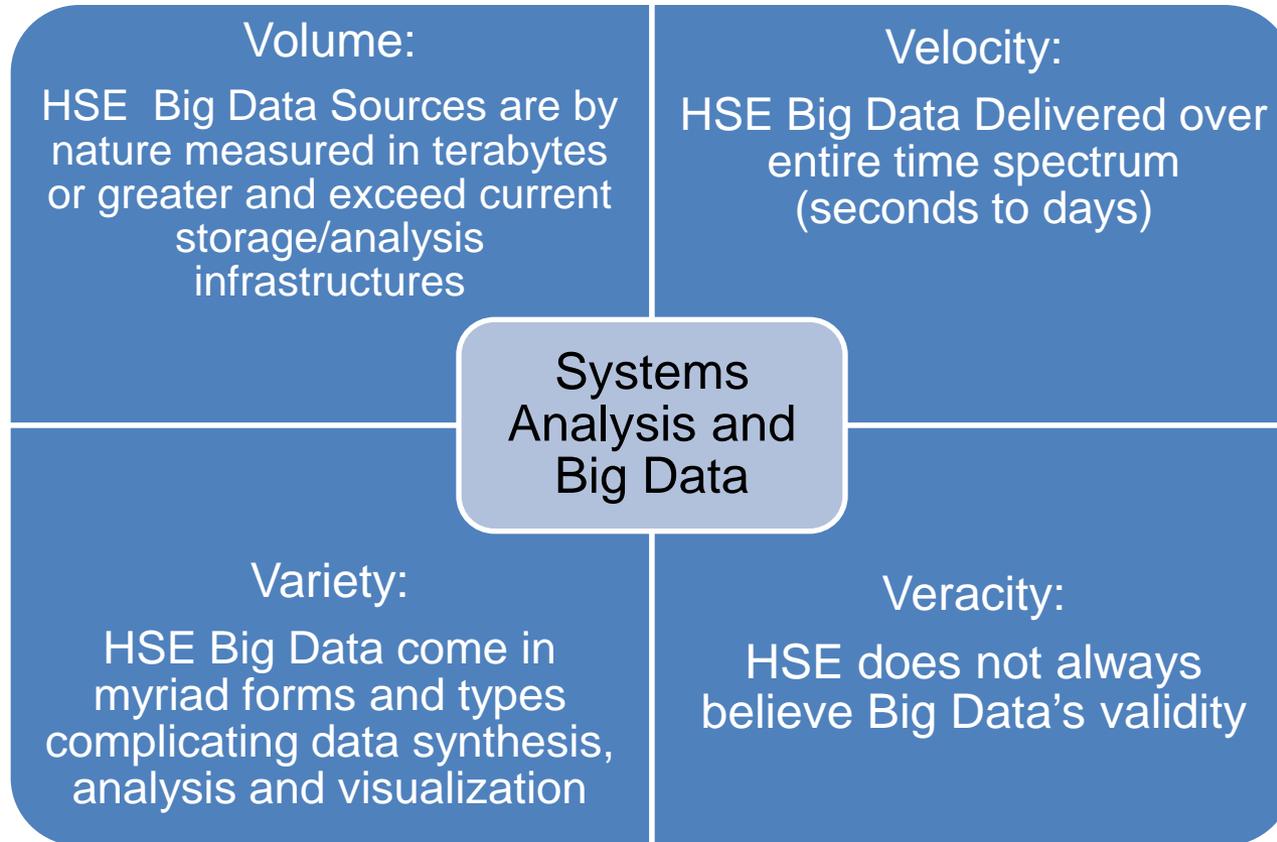
- To what degree must a Big Data solution rely upon proprietary data versus social media and data scraping?**

- To what degree will bureaucratic requirements and hindrances inhibit incorporation of Big Data solutions? Are there ways to mitigate inertia?**

Big Data



Dimensions of Big Data in the HSE



Examples:

- ***Command and Control***
- ***Sensor Networks***
- ***Passenger and Baggage Movements***
- ***Security Threat Pattern Recognition***
- ***Intelligence and Analysis***
- ***Import and Export Data***
- ***Cyber Threats***

BIG DATA! Problem & Context

❑ What are the DHS opportunities for next gen Big Data?

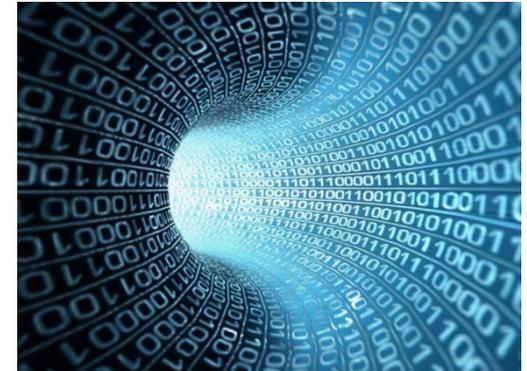
- DHS has access to high volume, high velocity and high variety data sets that can be used to define gaps, improve mission accuracy and increase efficiency.
 - USVisit – 42M biometric signatures
 - ✓ 4-6 second response needed to process, 1.2M screens per day (CBP)
 - USCert
 - ✓ 1M to 1B Transactions reviewed per day
- Current DHS data systems offer proprietary and limited access to specific pools of data.
- Emerging distributed capabilities are more accessible now in the IT market place.
- Building a good non-proprietary data architecture will enable DHS component missions



BIG DATA! S&T Experience

Working with components to define and implement operational Big Data architectures across DHS

- ❑ HSARPA has unique authority to experiment and examine opportunities for Big Data solutions
- ❑ Cross component architecture supports multiple missions:
 - Within a component:
 - ICE Counterproliferation -> Human Trafficking
 - Cross Component
 - ICE: Investigations -> CBP: Interdictions
 - USVISIT -> TSA, CBP
- ❑ Analyzing large data sets in motion and at rest: Cyber
- ❑ Leverage DHS CoE Command, Control & Interoperability Center for Advanced Data Analysis (CCICADA)
 - Large data set visualization, algorithms, scalable architectures



BIG DATA! Challenges

How should the Department prepare for big data solutions?

- ❑ What strategies will support the transition of S&T capabilities to operational Big Data architectures?
 - Privacy & Accreditation associated with spiral deliveries of capability on a 6 month cycle or less.
 - S&T Authorities to Experiment -> ICE Authorities to Operate
- ❑ What strategies might S&T use to convince components that big data solutions require a cultural change within their organizations?
 - Hire data analysis talent instead of agents
 - Career paths for data analysts



Big Data Questions

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Accelerating Innovation Through Systems Analysis

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Systems Analysis Questions

- How do responsible offices promote a culture of systems thinking within the broader organization?**

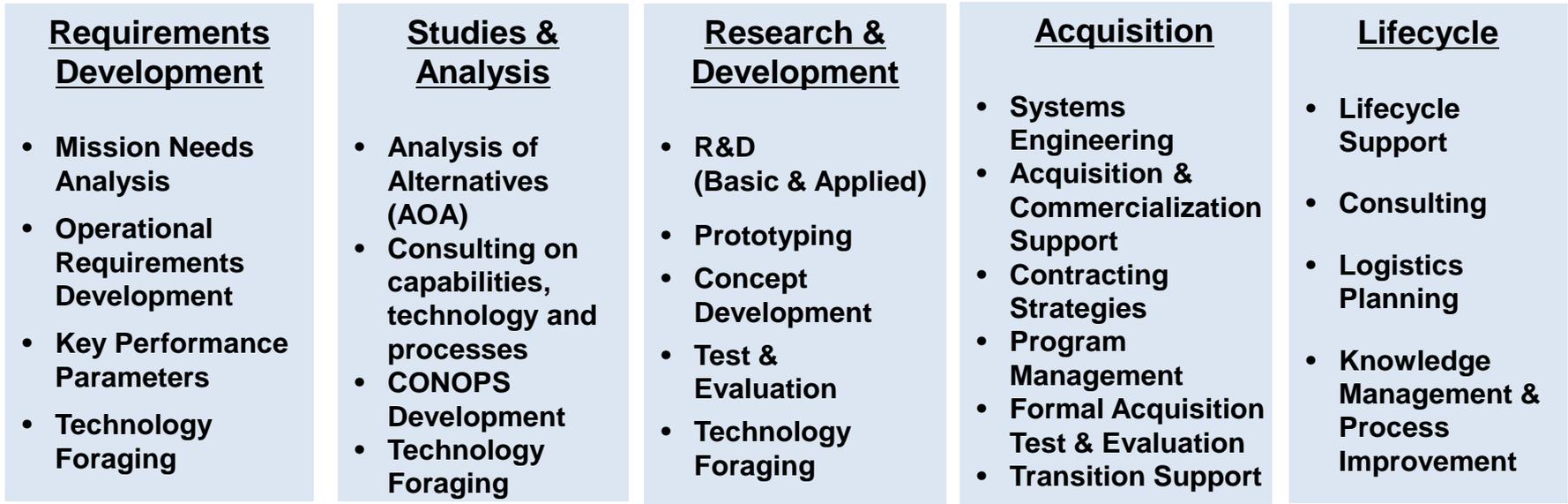
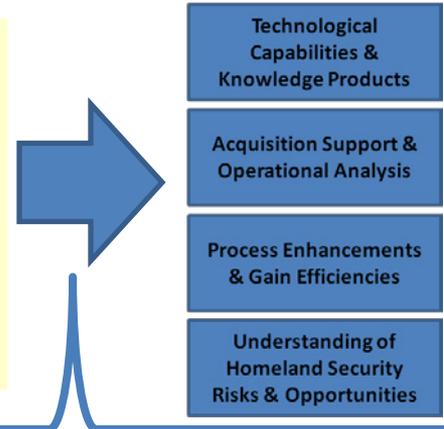
- What are effective strategies for eliciting accurate, measurable requirements from elements within the organization?**

- How do we deal with the creative tension between a rigid systems approach and a more amorphous approach to innovation?**

S&T's Value Added Proposition

Value Added Proposition for Supporting the Homeland Security Enterprise

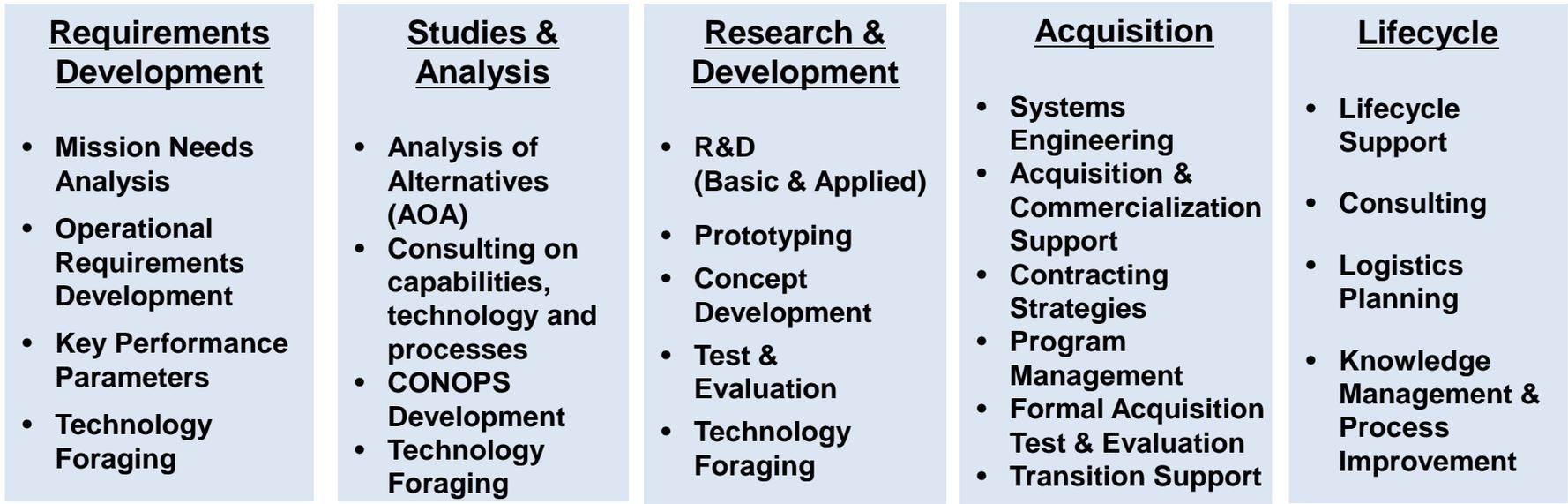
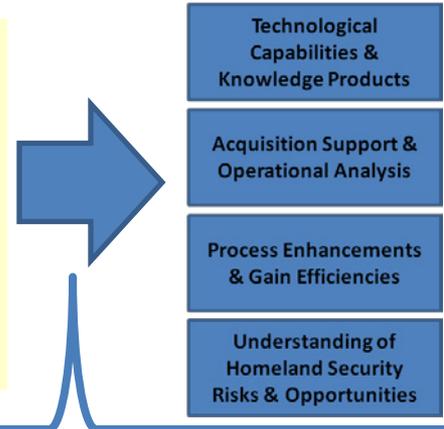
- ❑ S&T provides the HSE with strategic and focused technology options and operational process enhancements
- ❑ S&T seeks innovative, systems-based solutions to complex homeland security problems
- ❑ S&T has the technical depth and reach to discover, adapt and leverage technology solutions developed by federal agencies and laboratories, state, local and tribal governments, universities, and the private sector - across the US and internationally



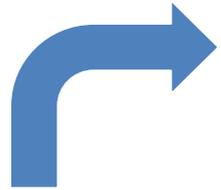
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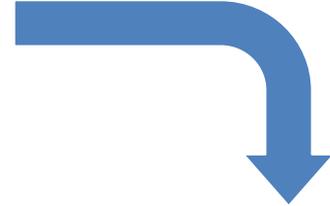
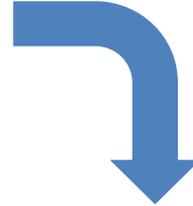
Science & Technology's Resource Allocation Strategy (STRAS)



Gain Component Head & USST Support

- Agree upon Mutual Goals
- Agree upon Co-Ownership
- Commit organizations to solution development and transition

GO / NO-GO DECISION



Work with Component to validate:

- Mission, priorities and gaps
- Assist in developing requirements
- S&T investment in the correct solutions

Systems Analysis & Technology Foraging

GO / NO-GO DECISION

Write Formal S&T/Component** Support Strategy**

- Document understanding
- Document expectations
- Document approach

Write Formal S&T/DHS** Support Strategy**

- Document understanding
- Document expectations
- Document approach



Current Portfolio

DHS/S&T

↔

Component

Science & Technology's Resource Allocation Strategy (STRAS) -- S&T View

Led by:

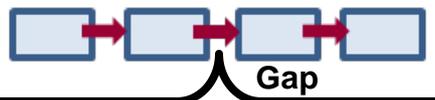
ASOA

HSARPA / FRG

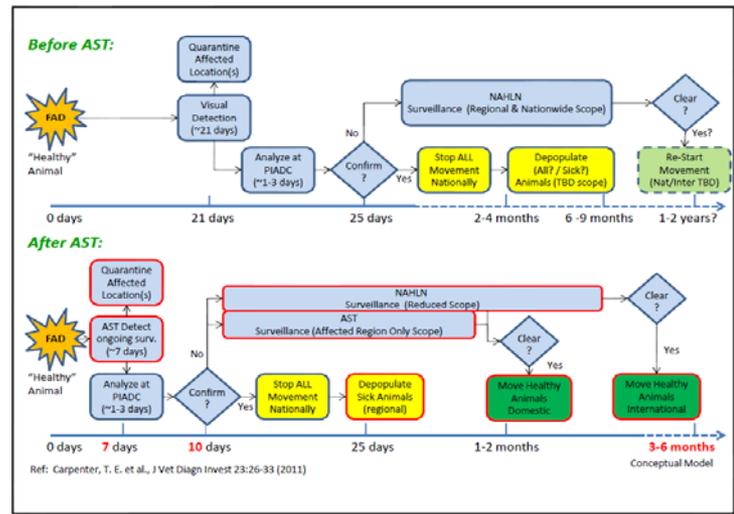
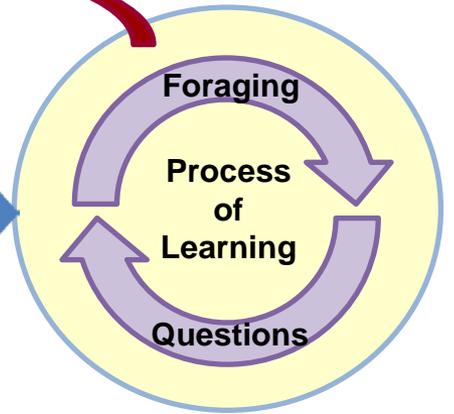
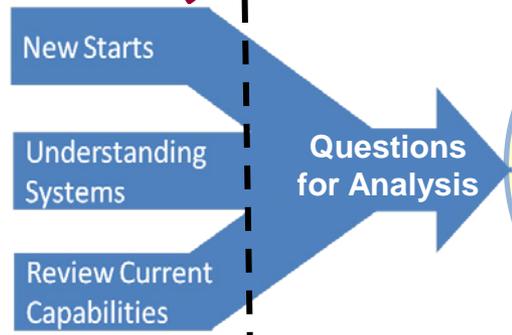
Systems Analysis

Systems analysis to ...

- Better understand the environment
- Identify questions for analysis
- Identify requirements
- Identify gaps



Technology Foraging



Ops Context Chart (OCC)

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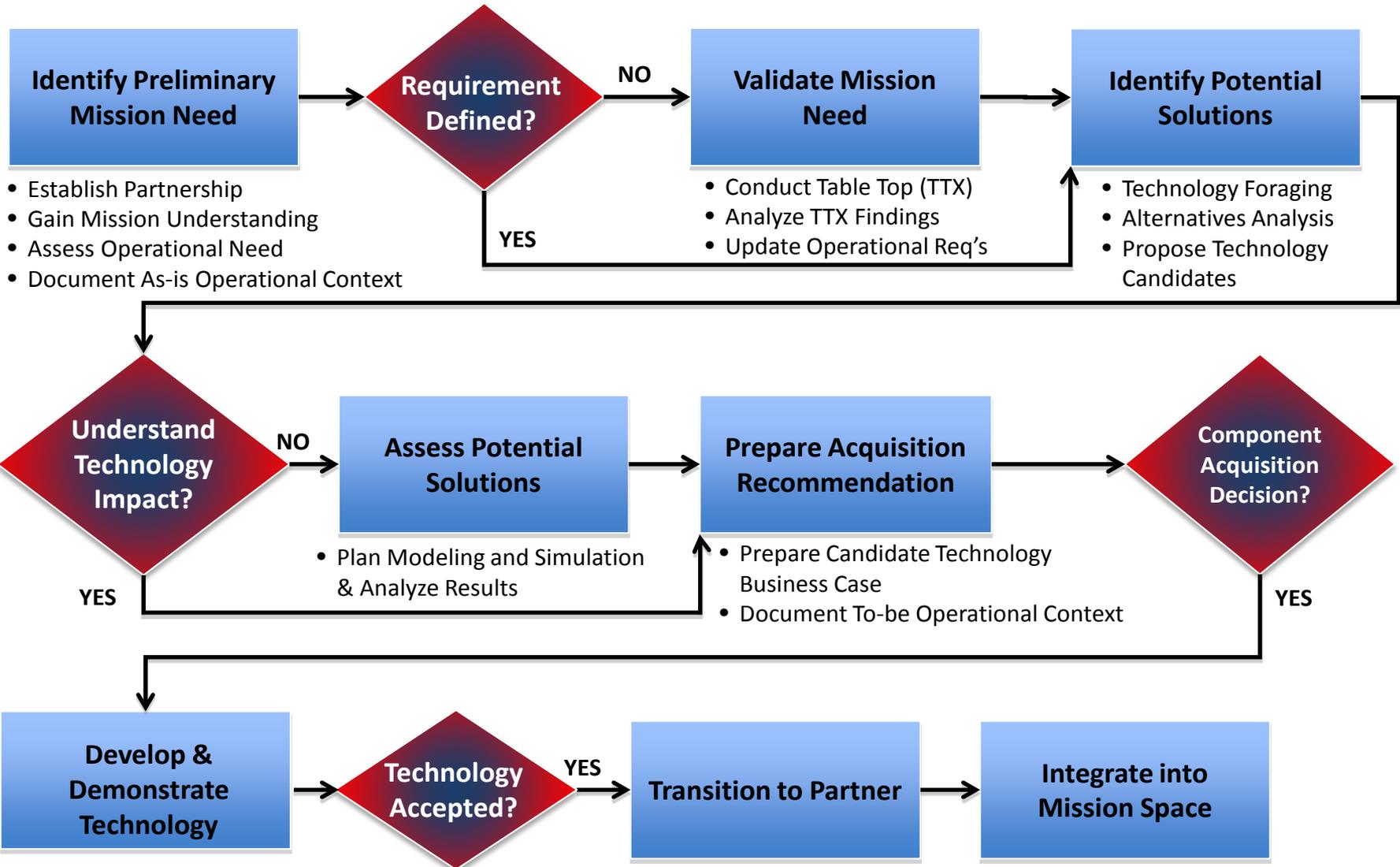
- RDP to Assist PMs
- All participate

Benefits:

- “System” definition
- Situational Awareness
- Speed of Execution
- Strategic Partnerships
- Portfolio refinement
- Resource Management
- Points of Contact

STORE System Analysis

Apex Team (S&T & Component)



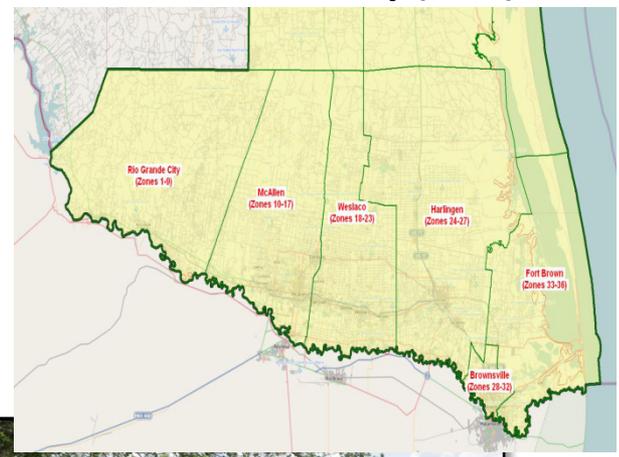
Rio Grande Valley (RGV) Systems Analysis

Problem: Validate & Address the Operational Challenges in the RGV

CBP Rio Grande Valley (RGV) Sector

Project Sequence

- 1. Problem parsing and definition**
 - Mission objectives, scenarios
- 2. Articulation of present-day operational scenarios & Concept of Operations (CONOPS)**
 - Agent roles
 - Environment and constraints
 - Technological tools
- 3. Assessment of potential technology solutions, impacts on CONOPS**
 - Understand “art-of-possible”
 - Filter, synthesize approaches
 - Consider COTS, GOTS, State-of-the-art
- 4. Synthesize solution options and provide guidance to potential Analyses of Alternatives and acquisition/procurement decisions**
- 5. Solution development, technology assessment, transition, and implementation.**

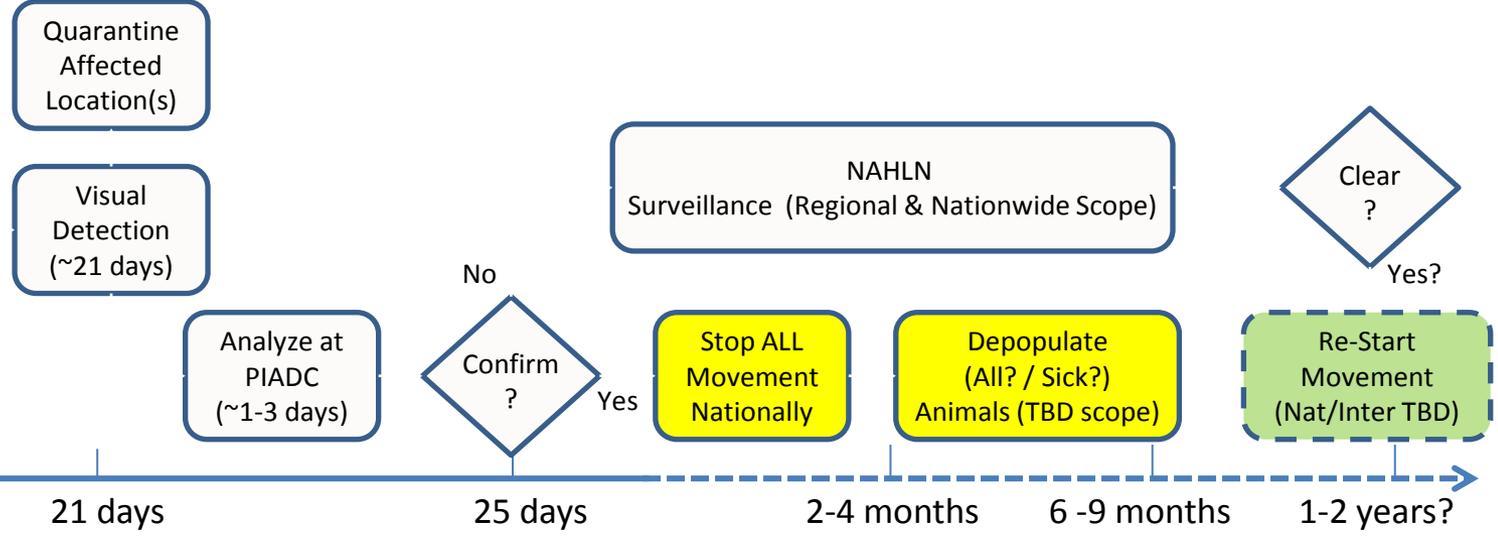


OCC – Ag Screening Tools (Before/After extracted from Detailed OCC)

Before AST:



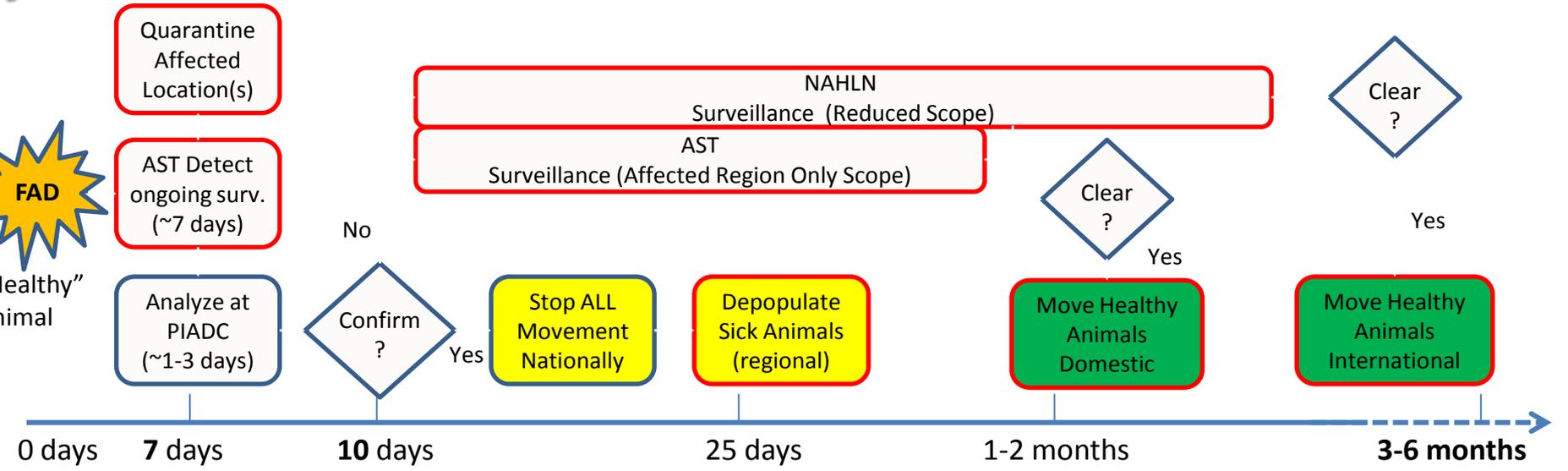
“Healthy” Animal



After AST:



“Healthy” Animal



Conceptual Model

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Leveraging Industry for Impact

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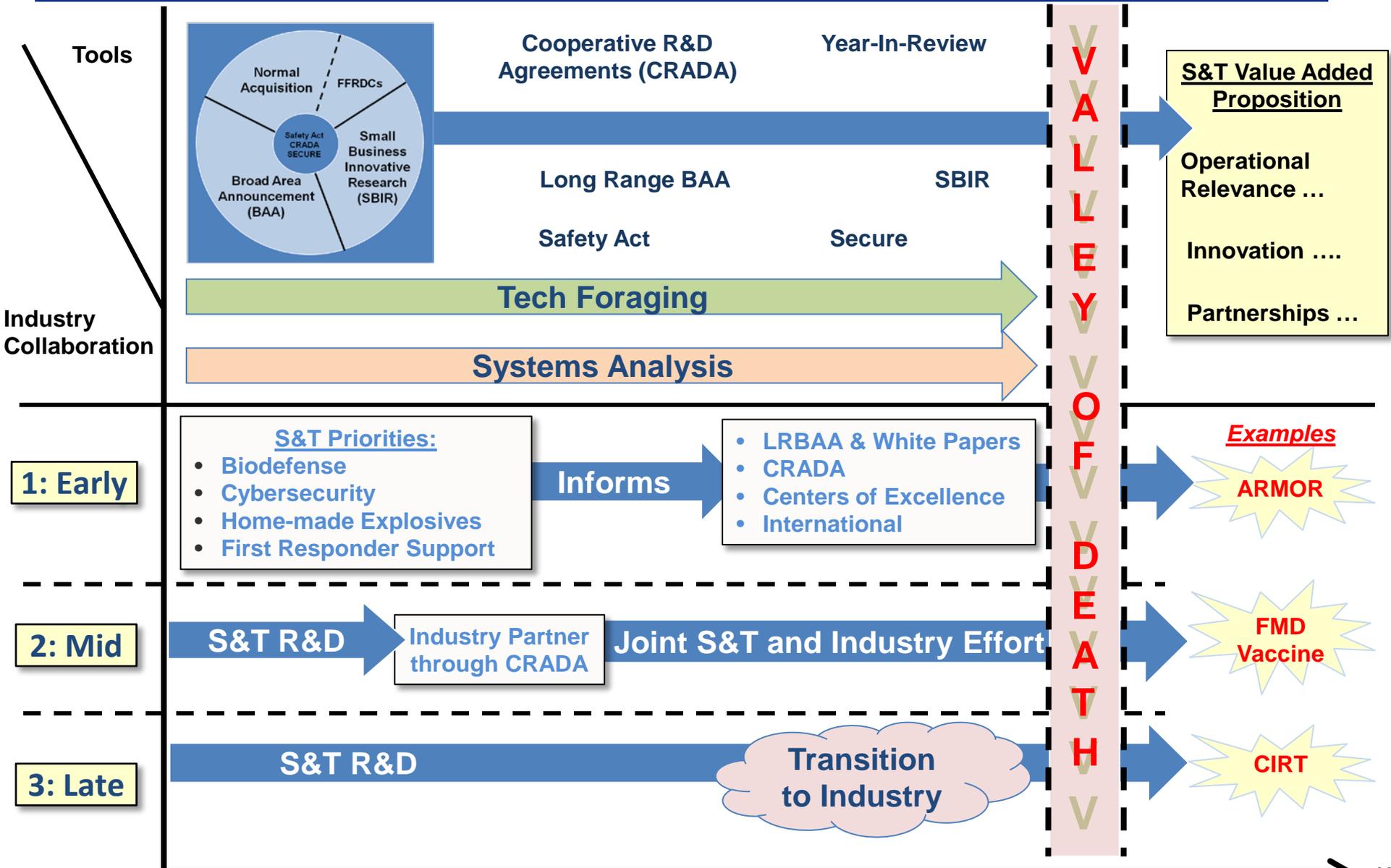
Industry Questions

- How might S&T improve the sharing of capability gaps, technology needs or other requests with industry partners?**

- How can S&T gain insight into industry trends and investment spending?**

- How might S&T leverage virtual tools to promote increased awareness with industry partners?**

DHS S&T Commercialization Paths



Multi-Use Product Lines

S&T develops technologies for homeland security to address catastrophic events that have no viable commercial business case

- **Examples of Unintended Applications of S&T Products:**
 - Levee Plug has components that are of interest to underwater manufacturing.**
 - Chemical detectors meant for cell-phones to provide ubiquitous sensing are finding significant commercial application as a personal carbon monoxide (CO) detector.**
- **How can S&T leverage commercial markets to help accomplish the homeland security mission?**
 - **Minimize producing “one-offs” or very low quantities such that products remain cost prohibitive to transition and/or maintain**
 - **Support a broader manufacturing base without diminishing the availability and capability for a product’s intended homeland security use**

HSARPA/Industry Multi-Use

Investigate multiple use products that have a nexus with the security and ancillary commercial applications

- Recommend best practices for planning and executing programs that lead to multiple use product lines.**
- What industry networks might better support multiple use products?**
- What venture firms are sensitive to multiple-use scenarios?**
- How does HSARPA ensure that security products remain supported by multi-use application manufacturing long term?**

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