NASA’s Systems Engineering Approaches for Addressing Public Health Surveillance Requirements

November 18, 2003
American Public Health Association
What is Systems Engineering?

Systems Engineering is 21st Century Engineering Practice...

- An interdisciplinary approach and means to enable the realization of successful systems;
- Integrates multiple disciplines and specialty groups into a coordinated team effort;
- Provides the framework for a structured development process that proceeds from concept to production to operation;
- Considers both the business and technical needs of all stakeholders with the goal of providing a quality product that meets user needs.
NASA’s Systems Engineering

Heritage in space mission analysis and design: The end-to-end approach to managing every facet of the extreme engineering required for successful space missions.
NASA’s Systems Engineering

Involves:

1. Understanding mission objectives;
2. defining requirements to meet objectives;
3. identification of functional, operational and constraint factors that impact each requirement
NASA’s Earth Science Enterprise is responsible for developing a scientific understanding of the Earth system to enable improved predictions of climate, weather, and natural hazards.

- NASA scientists use *remote sensing technology* as a tool to acquire detailed information about the Earth;

- Remote sensors collect measurement data on physical characteristics;

- These data can be used to characterize, understand and predict environmental phenomena;
PREMISE: NASA sensor technology, understanding of remote sensing, and knowledge of Earth system science, can be powerful new tools for improved disease surveillance and environmental public health tracking.

Earth Science Applications Goal

To expand and accelerate the realization of economic and societal benefits from Earth science, information and technology.

How is this different from NASA’s traditional aerospace engineering?

1. Applications strategy is built on federal partnerships;

2. Applications program is focused on adaptation and adoption of NASA’s Earth science data and technology;

3. Science and technology requirements are not NASA’s, they belong to the partner agency;
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4. Requirements may be difficult to define if a partner’s disease surveillance systems and tools are conceptual and/or are significantly different from what NASA has encountered before;

5. NASA is often unfamiliar with a partner agency’s mission, operations and organizational culture;

6. Disparate disciplines are brought together to work toward a common goal – often for the first time.
**Framework:**

1. Partner Needs
2. Define Problem & Baseline System
3. Investigate Alternatives
4. Design & Launch Phase (Model, Integrate, Demonstrate)
5. Assess Performance “Benchmark”
6. Enhanced Decision Support

**Approach:**

A systems engineering approach facilitates scalable, systemic, and sustainable solutions that contribute to the measurable enhancement of a partner agency’s disease surveillance system.
NASA’s Systems Engineering for Public Health

Partner Needs & System Requirements
Science/Data
Technology
Integration

Define Problem & Baseline System
Re-evaluate

Environmental Public Health Tracking Network (EPHTN)
ArboNET/Plague Surveillance
Rapid Syndrome Validation Project (RSVP)
Malaria Modeling

Partner Needs
NASA’s Systems Engineering for Public Health

DATA SOURCE

Orbital
MODIS

Sub-Orbital
AVIRIS

Ground
AERONET

ACCESS & DELIVERY

Information Systems

COMPUTATIONAL TECHNOLOGIES

Modeling

Investigate Alternatives

Re-evaluate

PLUME DISPERSION MODEL
Fruit fly wing beat signatures were between 230-260 Hz

Moth wing beat signatures were between 20-60 Hz
NASA’s Systems Engineering for Public Health

**DECISION SUPPORT REQUIREMENTS**

- Data
- Access & Delivery
- Computational Technologies
- Technology Innovation

**Enhanced Decision Support**

**Design & Launch Phase** (Model, Integrate, Demonstrate)

**Assess Performance “Benchmark”**

Re-evaluate

Re-evaluate

**Environmental Public Health Tracking Network (EPHTN)**

**ArboNET/Plague Surveillance**

**Rapid Syndrome Validation Project (RSVP)**

**Malaria Modeling**

**Improved Management & Policy**
1. NASA sensor technology, understanding of remote sensing, and knowledge of Earth system science, can be powerful new tools for improved disease surveillance and environmental public health tracking.

2. NASA’s systems engineering framework facilitates the match between partner needs and decision support requirements:
   - Science/Data
   - Technology
   - Integration

3. Goal is systemic and sustainable solutions that contribute to the measurable enhancement of a partner agency’s disease surveillance efforts.
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**Title and Subtitle:**
NASA's Systems Engineering Approaches for Addressing Public Health Surveillance Requirements

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**Sponsoring/Monitoring Agency Name(s) and Address(es):**

**Distribution/Availability Statement:**
Publicly Available STI per form 1676

**Supplementary Notes:**
Conference - Presentation at American Public Health Association

**Abstract:**

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**Subject Terms:**

**Security Classification of:**
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**Limitation of Abstract:**
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**Number of Pages:**
14

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