Algorithm Development for Security Applications (ADSA)
Workshop 6:

Development of Fused Explosive Detection Equipment with Specific Application to Advanced Imaging Technology

Workshop Objectives
ADSA05 Review

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“I believe that most people came away with a sense that fusion is much more difficult to do than one's initial perceptions.”

Rule #1 – Open Discussions

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  - Discussion required to fill in gaps
  - Fewer presentations than previous workshops to allow more time for discussion.
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- Applies to participants from academia, industry, government and national labs
- Moderators responsible for keeping discussions focused
- Not grip-and-grin

ADSA06 Objectives

- Address the generalities of fusing systems
- Specific application to AIT (Advanced Imaging Technology), which is personnel screening/imaging
- Discuss how to develop technologies when they are fused you know that better performance will be obtained
- Involve third parties in the development of and fusing new technologies

Fusion Generalities

- Definitions: fusion, orthogonal, technology
- TSA requirements
- Identification of strengths and weaknesses of existing equipment
- Requirement specifications
- Procurement, installation, testing, maintenance
- Interconnections, networking, standards
- Concepts of operation
- Third-party involvement including dealing with classified requirements
- Adaptive screening

AIT Application

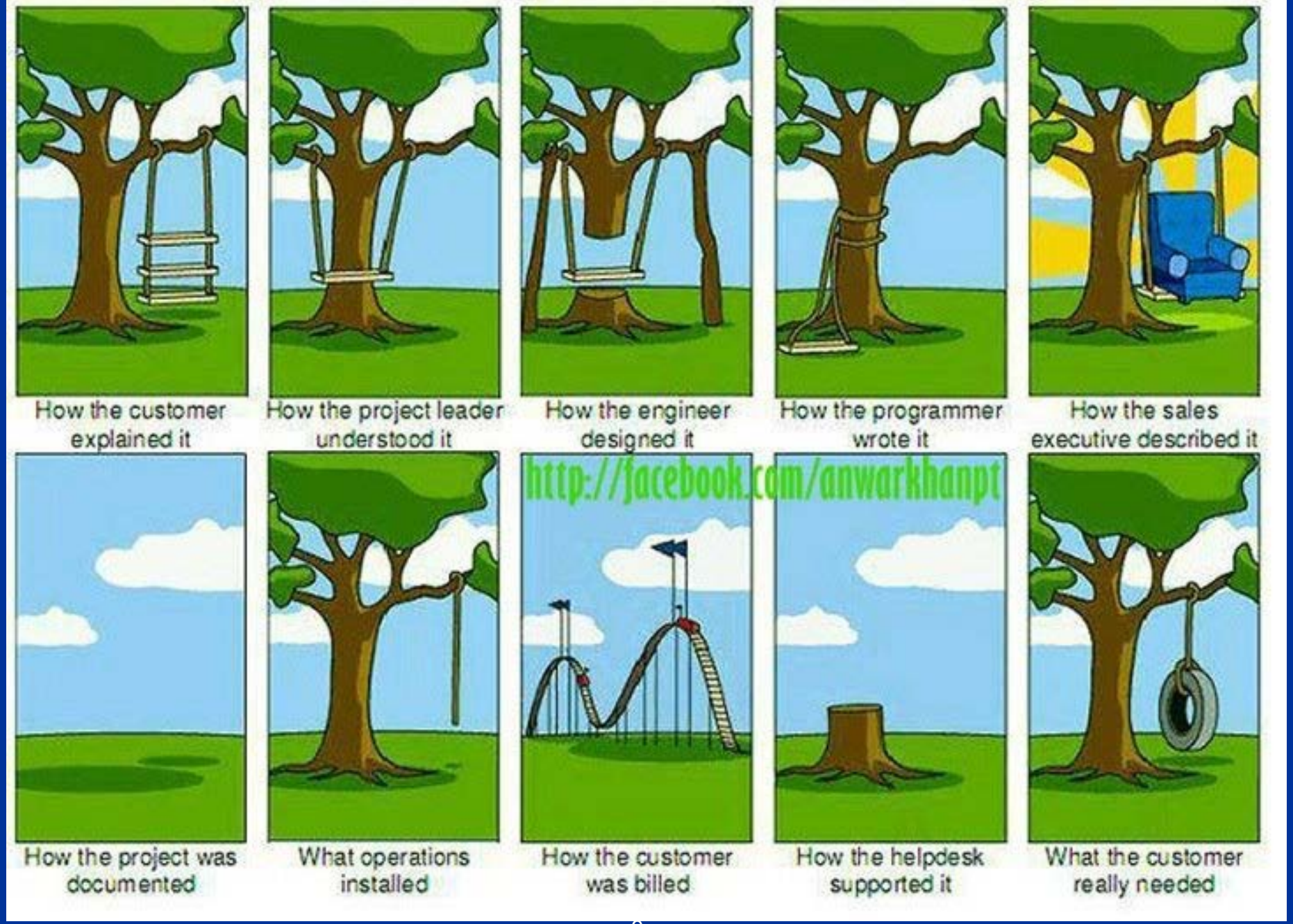
- Identify strengths and weaknesses of existing AIT
  - Primarily x-ray backscatter (XBS) and millimeter wave (MMW)
- Find technologies to fuse
  - May not be existing XBS and MMW
  - Prospective proof that A+B is improvement
- Discuss how to develop and deploy fused system

ADSA05 Overview

- High-level look at fusion
- Definitional issues with *fusion*, *orthogonal* and *technology*
- Emphasis was on data fusion instead on designing fused systems that improve detection performance

ADSA05 - Terminology

- Finding: DHS is not well educated in fusion and its terminology.
- Recommendation: DHS should define terms used by fusion experts in R&D and other fields.


How the customer explained it
How the project leader understood it
How the engineer designed it
How the programmer wrote it
How the sales executive described it
How the project was documented
What operations installed
How the customer was billed
How the helpdesk supported it
What the customer really needed
http://facebook.com/anwarkhanpt

Is this fusion?

Appears to be layered solution.

Look Deeper

XBS

BDO

?

Intelligence

TRX

Common
Network
Protocol

MMW

Data Fuser

Sensor
(Ven. A)

Recon
(Ven. B)

ATR
(Ven. A)

ADSA05 - Experience

- Finding: DHS has experience with fusing systems and some of these have failed.
- Recommendation: Need to learn why these systems failed.
- Recommendation: Need to focus on a particular problem and try to solve it to set precedence.
- Recommendation: Need to establish performance metrics to be able to judge effectiveness of individual sensor systems and compare improvements due to fusing two or more systems.
- Recommendation: Address how technologies are designed and chosen so that, when fused, the resulting fused system has better performance than existing technologies.

ADSA05 – Adaptive Screening

- Finding: Adaptive screening was discussed, but was not part of the workshop.
- Recommendation: This topic needs to be a focus and discussed.

Problem

- Terrorists still trying to take down airplanes
  - Huge economic impact
- Terrorists are making home-made explosives (HME)
- Need better detection performance
  - More types of explosives
  - Lower masses
  - Increased probability of detection (PD)
  - Decreased probability of false alarm (PFA)

DHS Tactics

- *Augment* abilities of system vendors with 3rd party involvement
- 3rd parties
  - Academia
  - Industry other than system vendors
- Create centers of excellence (COE) at universities
- Hold workshops to educate 3rd parties and discuss issues with involvement of 3rd parties

Augmenting System Vendors

- SAIC/Reveal
- L-3 Communication
- Analogic
- Morpho Detection (formerly GE Security and InVision)
- AS+E
- SureScan
- Rapiscan
- Smiths Detection

Excellent equipment developed by very smart people.
Material supplied by most of these vendors.

Progress With Tactics

- 3rd party industry working with system vendors and receiving government funding
- Students trained and working for national labs and industry
- Professors consulting to industry
- Students working on AIT projects
  - Sandia dataset made available for these projects
- Grand challenge for CT segmentation in progress
  - Symposium to report results on 12/8/2011
- Funding vehicle in place for ALERT
- New transitional projects for fusion, video and CT reconstruction
- DICOS spec released
  - DICOM equivalent for security
- 300 people involved with workshops

More on this topic from Silevitch and Parker

Questionnaire

- Request for everyone to answer questions preferably during the workshop
- Hand in at end of workshop or email
- Typed or handwritten acceptable
- Name is optional

Question - 1

- What should the definitions be for *fusion*, *orthogonal* and *technology*?
  - Are *layered* systems (humans plus technology) the same as *fused* systems?
  - Are PET and CT systems *orthogonal*? Are they *fused* in current medical applications for cancer detection?
  - Do systems have to "talk with/guide each other" to be fused?

Question 2

- Are there existing technologies that have sufficient evidence for their potential as a fused system with improved detection performance?
  - What is the *evidence* (e.g., literature, internet, reports) that fusing existing technologies would lead to improved detection performance?
  - What would be *attributes* of technologies which would best fuse with each of these systems? Do such technologies exist today?
  - What is the evidence to support that AIT and x-ray back scatter technologies are attractive fusion candidates?
  - What other technologies could be fused to improve the detection performance of AIT systems?

Question 3

- How is detection performance improved with adaptive screening?
  - What is the definition of adaptive screening?
  - How should risk be assessed?
  - How should risk be fused to explosive detection equipment?
  - Should adaptive screening be used?

Question 4

- Which investment is likely to have the highest rate of return?
  - Fused system identification (which systems to fuse) and performance evaluation
  - Algorithm development (segmentation, reconstruction, artifact reduction, ATR)
  - System simulations
  - Integrating systems and then fusing their results

Question - 5

- What changes need to be made by the TSA to allow fused systems to be deployed?
  - What are the developmental steps between identification of attractive fused detection systems and acquisition of such systems by TSA? (Describe the research, DT&E, OT&E, and acceptance testing required, necessary resource levels and the timeframe to accomplish it.)
  - What are the implications of fused technologies on the DICOS developmental effort and emphasis?
  - What is needed by traditional vendors to gain their enthusiasm for fused system development? (e.g., IP and patent protections, data on real threats, etc.)

Questions 6 & 7

- What changes need to be made by DHS S&T to fund the research and development of fused systems?
- How can third parties better be marshaled to accelerate development of optimally fused detection systems?
  - How can projects be given to third-parties who cannot access classified information?
  - Which projects are suitable for third-parties?

Agenda Day 1

- Fusion development and deployment - Parts I&II
- Examples of fusion in medical imaging
  - PET/CT
  - Combined optical and x-ray Mammography
- AIT: X-ray backscatter & MMW review
- DHS comments on involvement of third parties
- Third party success stories
- Topics for next workshop (ADSA07)
- Reception sponsor
- Dinner Speech - Fostering innovation in aviation security

Agenda Day 2

- Sensor Fusion for PBIED Detection
- Fusion in DoD
- Fusion opportunities at the checkpoint
- Fusing MMW technologies
- MMW using backscatter and quantitative material characterization
- Adaptive screening
- How might technology improve human performance in the detection process
- Next steps & open discussion

Barriers for 3rd Parties

- Access to data and scanners
  - Proprietary and classification issues
  - Non classified material may lead to classified material
- Classified requirement specifications
- Publications may be blocked
- Short time frame
  - DHS is reactionary
- DHS/TSA is not NIF, NSF, DOD
  - Difficult to spend money

DHS is trying to remove these barriers.
Working with industry is easiest path.

Workshop Changes

- More discussion time
  - Non-working and longer lunches, breaks and social period
  - Fewer speakers at dinner session
- Moderators being more active
  - Ask speakers for conclusions at start of talk
  - Ask audience to discuss presentation in real time
- Less adherence to agenda

Participant Identification

- Please identify yourself and institution first time you speak or ask questions
- Minutes will be taken, but edited for final report

Deliverables

- Written report to DHS addressing goals set forth on previous slides
  - Released to public
- Report written based on
  - Presentations
  - Discussion
  - Questionnaires
  - Minutes

Acknowledgements

- Northeastern University (NEU)
- Awareness and Localization of Explosives-Related Threats (ALERT) Center of Excellence
- Department of Homeland Security (DHS)
- Lawrence Livermore National Laboratory (LLNL)

Acknowledgements

- Speakers
- Participants

Logistics

- Mariah Nóbrega
- Rachel Parkin
- Brian Loughlin

Let them know if you need support during or after workshop.

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Rule #2 – Public Domain

- Do not present classified or SSI material
- Presentations, minutes and proceedings will be placed in the public domain after review for SSI and classified material

Rule #3 - Questionnaire

- Fill out questionnaire
  - Key element of deliverable to DHS
  - E-mail or hardcopy

Rule # 4 – Speaker Instructions

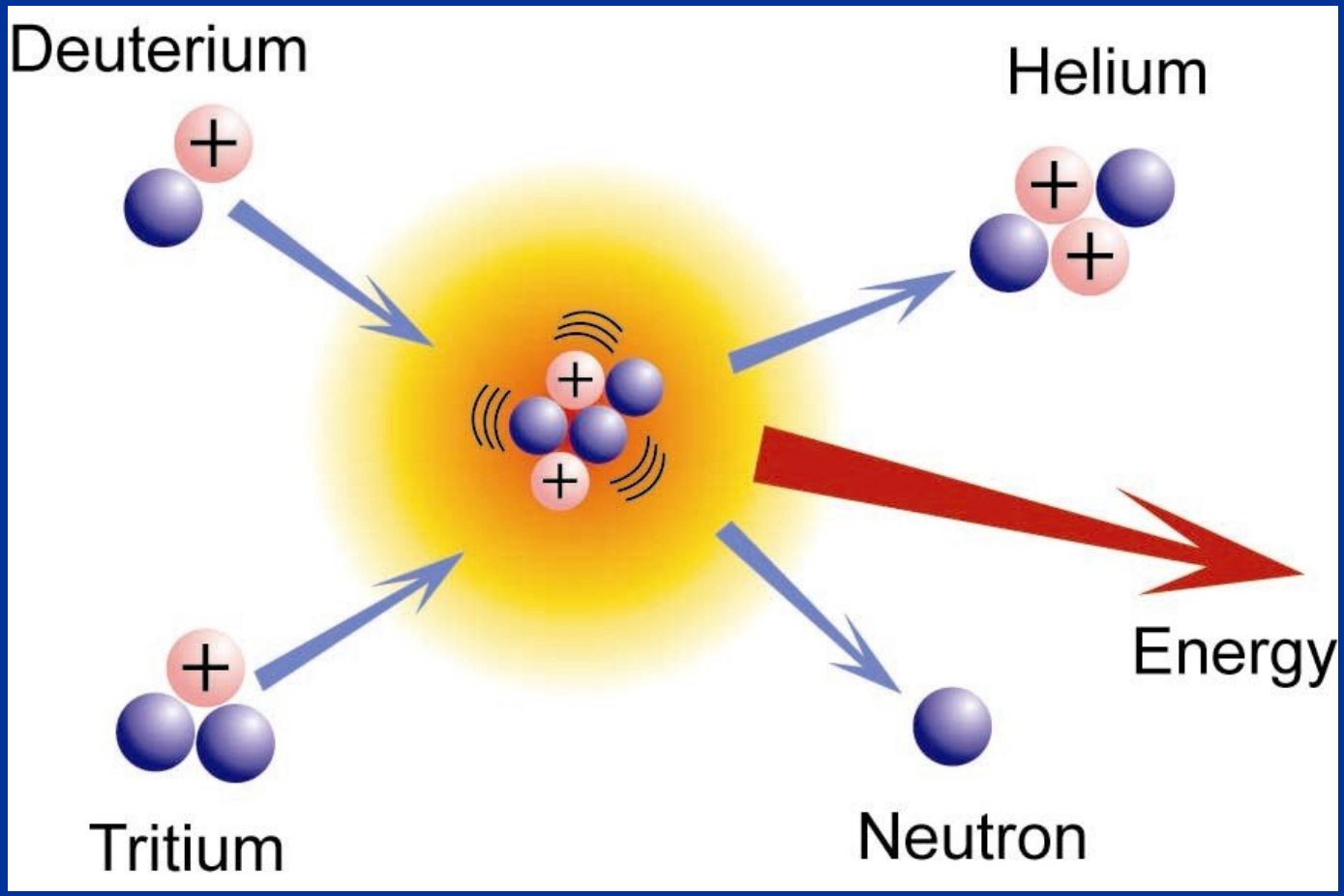
- 2nd slide should be conclusions
- Allocate 50% of time slot for discussion
- Do not repeat material from prior speakers
- Expect discussion during presentation
- Provide presentations in advance of your session to ALERT staff

Delete slides now if necessary!

Disclaimers

- This workshop was prepared as an account of work sponsored by an agency of the United States government. Neither the United States government nor Northeastern University nor any of their employees makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.

Takeaway – Material does not necessary reflect DHS and TSA policies.



Learned much at ADSA05 (first workshop on fusion).
Let's build on what we learned during this workshop.

Final Remarks

- "Terrorism causes a loss of life and a loss of quality of life," Lisa Dolev, Qylur
- Need improved technology
- Thank you for participating