DTEK^{TM}
Quantitative Optical Inspection

Presented to ERAI Executive Conference, Las Vegas, NV

COVISUS

Leonard Nelson
May 18, 2012

Agenda

- Story of two plane crashes

- Quick intro to DTEK surface analysis

- An important change in our design approach

- Gaps addressed by DTEK

- Validation of the method

- Questions posed by ERAI members

US Airways Flight 1549

- January 15, 2009

DTEK Offering Summary

- Non-destructive tool to aid inspection of electronic components through surface analysis

- **Cost:** $15K / year subscription + implementation

  – Ongoing part updates

  – Customized reporting

  – Algorithm improvements

- **Time:** 15 seconds per component tested, under 5 min lot cycle time for trained user

DTEK 2.1 System

Anti-Counterfeit Technology Background

- Supply chain security technology funded by the US Army Research Office by ChromoLogic LLC

- ChromoLogic is a diversified research & development firm base in Pasadena, CA. Covisus is a wholly owned subsidiary of ChromoLogic LLC

  – Capabilities in optics, information processing, diagnostic tools, and spectroscopy

  – 30 employees, 12 PhD Scientists

"Counterfeiting, theft and diversion of military equipment are significant issues within the Army especially during times of warfare. A rapid, unambiguous tool for identifying a variety of materiel for both military and civilian locations in which verification of the identity of that materiel is critical."
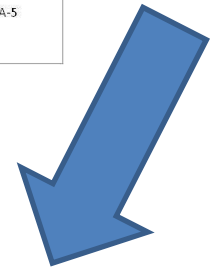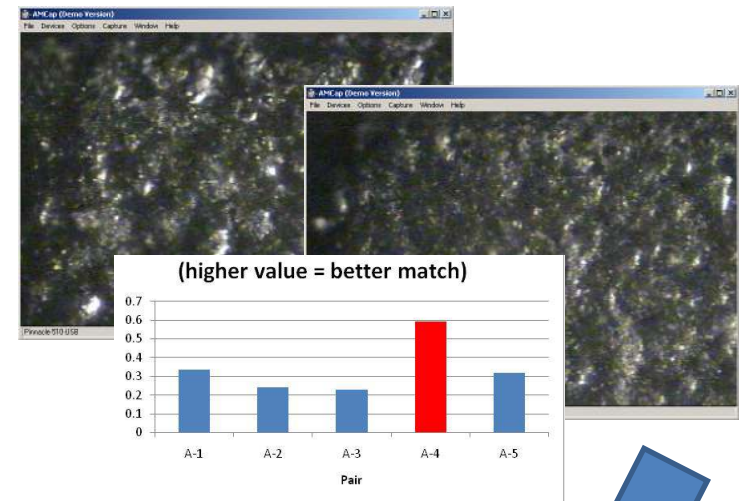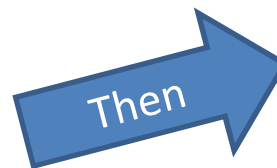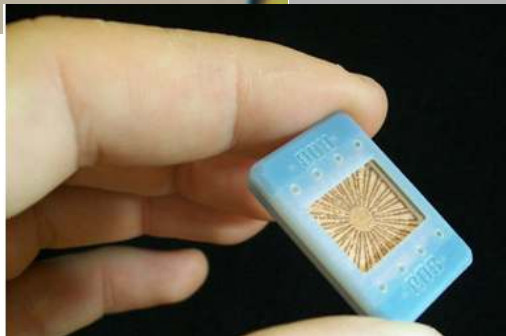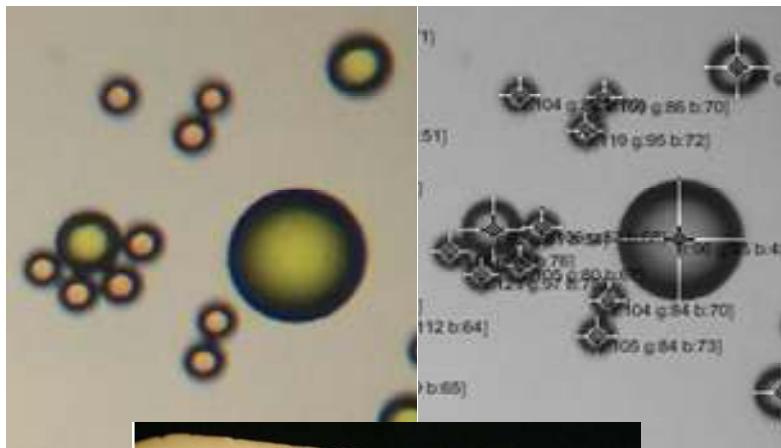
- US Army Research Office

Early Research in Counterfeit Mitigation

Intrinsic Surface Traceability

Secure Tracking Tags

Then

Comparative Surface Analysis

Product Progression

Version TRL Level Date	Version 0.2 TRL 6 Dec 2010	DTEK 1.1 TRL 7 July 2011	DTEK 2.0 TRL 7 Dec. 2011	DTEK 2.1 TRL 7/8 May 2012
Hardware				
Data Entry Time (min per lot)	6 minutes	5 minute	15 seconds with barcode integration	15 seconds with barcode or instant (0 sec) with ERP integration
Scan & Analysis Time (min per component)	4 minutes	1 minute	Per component: 30 seconds full batch time, < 1s scan time	Per component: 20 seconds full batch time, < 1s scan time
Key Features	Field validation on "blacktopped" counterfeits	Enhanced precision, drastically enhanced scan speed.	Custom glancing angle illumination, barcode integration, five component tray, ESD safety.	Modular design, ESD enhancements, increased precision. API for ERP integration in development

DTEK Design Change

- **Original Goal:** Remove the human element from the inspection process
    - Fool-proof tool
    - Reject or accept part based on result

- **Lesson Learned:** The human element will likely *never* be removed

- **Current Goal:** To augment and enable the visual inspector
    - Efficient, effective, adaptable

Observed Industry Shift

- **Old paradigm:**
  - Sales organization with sufficient quality systems
  - Some tradeoff between throughput and quality tolerated

- **New paradigm:**
  - Independent distributors as hybrid test labs
  - Demand <u>zero</u> tradeoff between throughput and quality
  - Yet: same demands for short lead times, cost, throughput, and availability

- **Question:**
  - What happens when information, documentation, and testing requests overwhelm your people and systems?

Continental / Colgan Flight 3407

- February 12, 2009

Visual Inspectors

- Largest investment in quality

- Highest "ROI" for counterfeit mitigation

- Counterfeit mitigation = reputation

- Today, visual inspectors are increasingly critical:

  - MUST be efficient information conduits between suppliers, salespeople, management, customers, regulatory/certification bodies, and other distributors

Visual Inspectors: Weaknesses

- Conscientiousness
- Company culture (Pressure)
- Confirmatory bias
- Human perception bias
- Illusion of control
- Learning plateau

Human Perception Bias
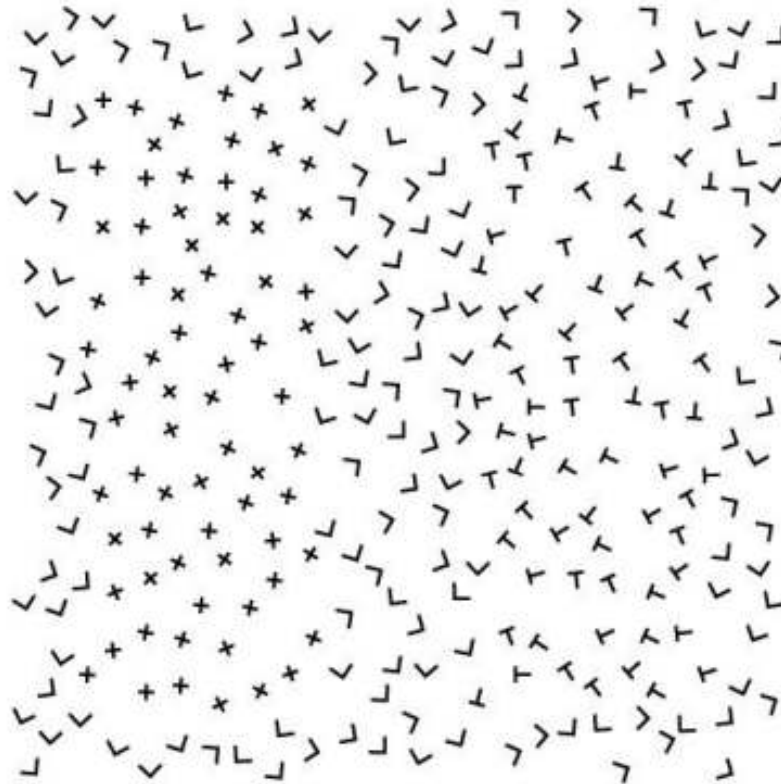
Human beings have a visual perception bias against random patterns.[1,2]

1. *Characterizing the Limits of Human Visual Awareness. Huang, L. Science. Vol. 317 no. 5839 (2007)*
2. *Visual Perception of Texture. Landy, M. New York University. 2002 (source of image above)*

Human Perception Bias, Continued

1960s

Today

Random Patterns are Important Because Component Surfaces are Important

- Approximately **80%** of identified counterfeit components have altered surfaces[1]

- Remarking or resurfacing is accomplished by counterfeiters through variety of different techniques include, but are not limited to:

  - **Blacktopping:** Painting the surface of the component with a color matching the component packaging and then adding new part markings. The surface may be sanded prior to blacktopping to remove the old margins.
  - **Epoxy coatings:** The surface is coated with a compound resembling the original mold compound with a similar chemical composition prior to remarking
  - **Microblasting:** A micro-etching tool is used to remove the part markings and superficial surface layers of the component prior to remarking.
  - **Lapping**: A machine or manual flat lapping tool is used to resurface the top of a component, typically on ceramic ICs.

Microblasting can be used to alter component surfaces

[1]Defense Industrial Base Assessment: Counterfeit Electronics, January 2010, US Department of Commerce Bureau of Industry and Security
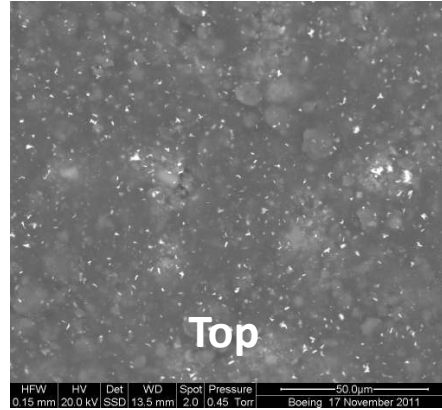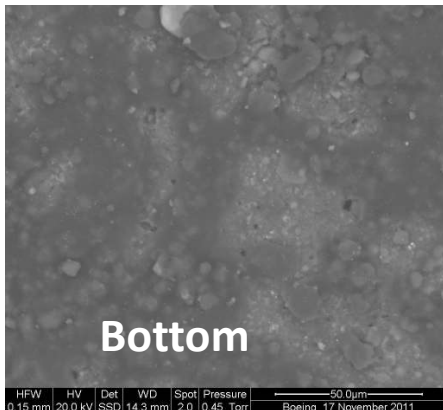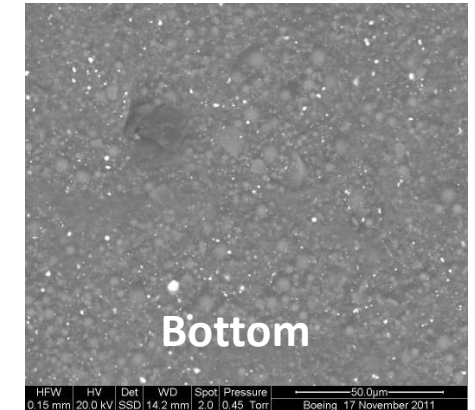
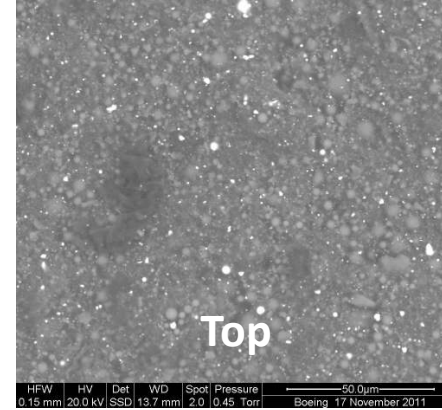# Component Set 2: SEM Inspection
Xilinx XC3030A

FEI QUANTA 600F

Epoxy-Coated Counterfeits
1000X

Authentic
1000X

DTEK Inspection: Xilinx XC3030A

DTEK Top Surface Quantitative Comparison:
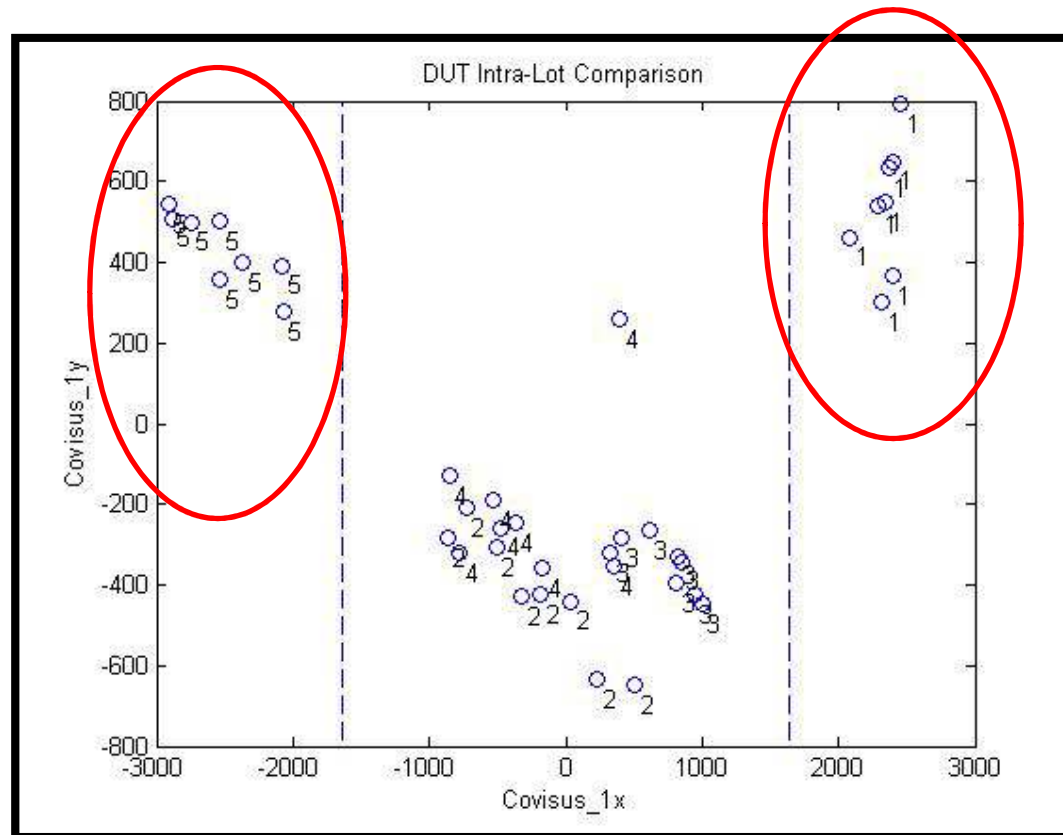XC3030A Test Lot (Counterfeit) vs. Reference Sample (Authentic)
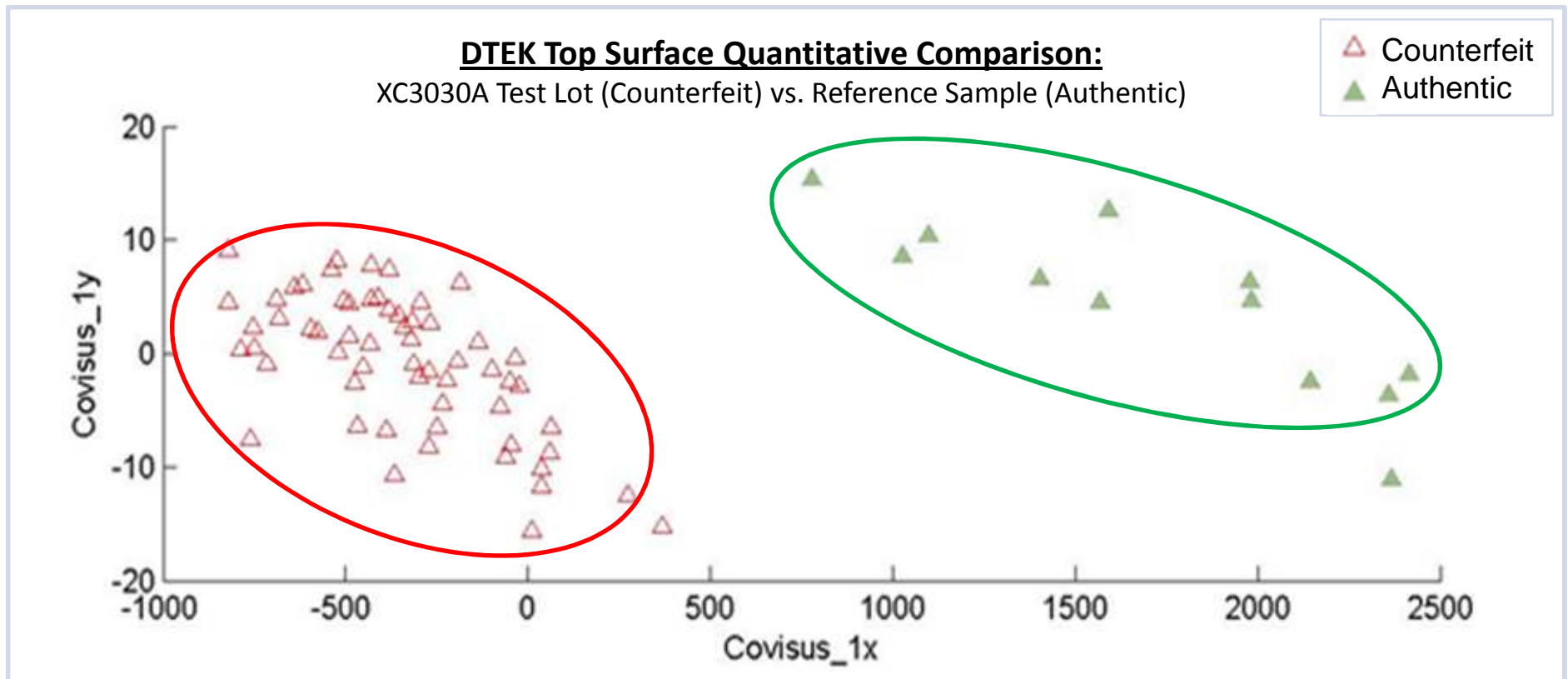
Plot shows clear difference between re-marked counterfeit (red) and original surface (green) values.
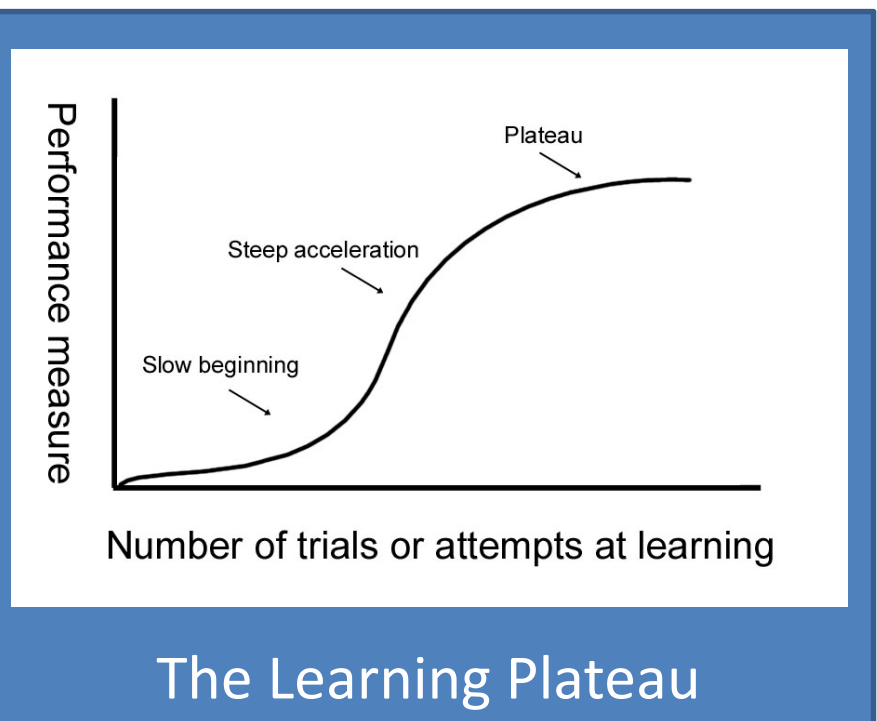
Lot Conformance

- Tells inspector which components have the:
  - Least consistent surfaces in the sample
  - Most consistent surfaces in the sample

Adaptive Learning & Updates

- Counterfeit techniques always changing

- New analysis techniques present themselves

- New visualization tools and methods deployed

The Learning Plateau

Additional Questions

- Does QSA / DTEK replace other analytical techniques?

- If a "golden sample" needed in order to gain usable results?

- What types of components that can be screened?

- What are the required or recommended lot sizes needed for analysis?

- Costs associated with buying, using and maintaining the DTEK system

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Additional Questions

- Do lot-to-lot variation or different manufacturing facilities can cause "false positive" results?

- What type of training needed to operate the equipment and analyze results?

- What are the safety considerations for using DTEK technology?

Thank You & Contact Information

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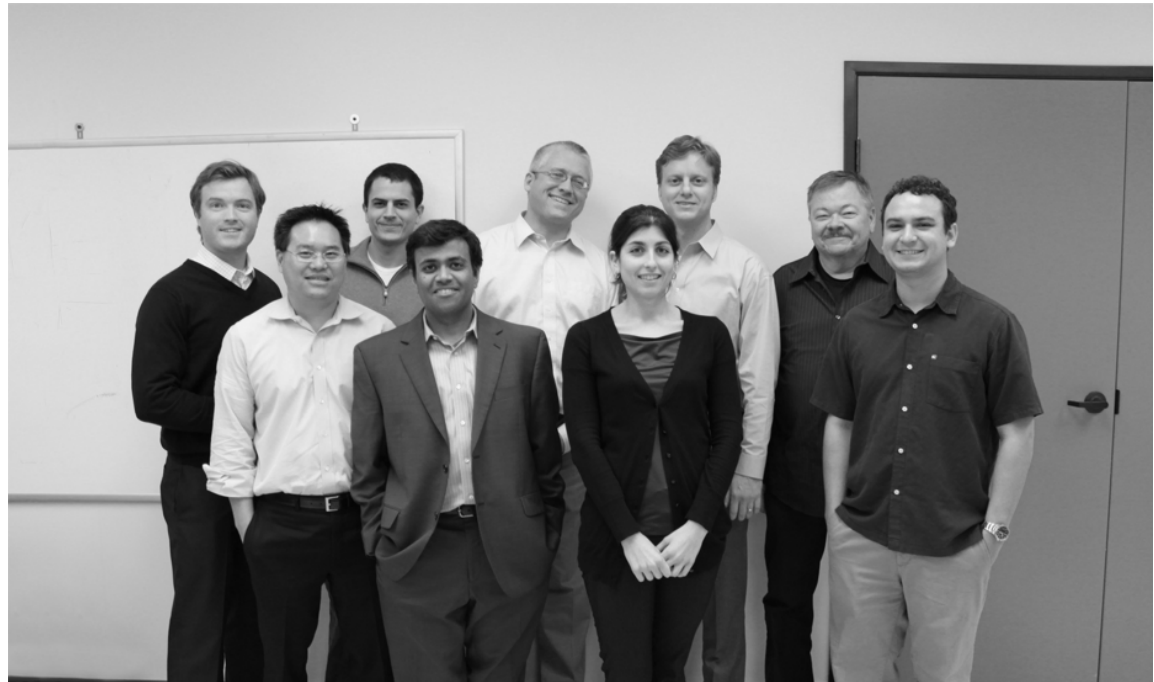www.covisus.com

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DTEK Design Team (from left): Skylar Gauss, Lawrence Yu, Jordan Crede, Naresh Menon, PhD, Dan Reiley, PhD, Masha Belyi, Leonard Nelson, Orin Serviss, Andrew Dyer. Not pictured – Theresa Nguyen, George Kryboyan, Greg Bearman, PhD