

# *The Black Swan(s) & Transformative Technologies at Dahlgren*

- An informal discussion of the future

September 16, 2011

## □ **Innovation concepts**

### □ **Black Swan**

- **Introduction**
- **My take**
- **At Bell Labs and ICTAS**
- **At Dahlgren**

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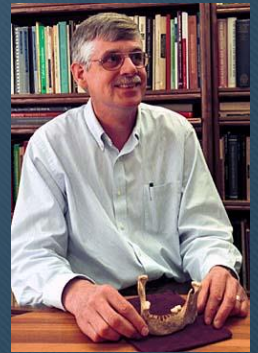
# Innovation concepts

## 1. Human Spark

- Neanderthals and modern humans evolved from the same ancestors.
- Neanderthals left Africa and spread to Europe where they lived for about 200, 000 years before they became extinct.
- Those left behind successfully evolved to modern humans and occupied the planet.



DO YOU KNOW WHY?



# Innovation

**“Just as energy is the basis of life itself, and ideas the source of innovation, so is innovation the vital spark of all human change, improvement and progress.”**

**Ted Levitt; Marketing Guru, Harvard Business School**



## 2. Invention vs. Innovation

### INVENTION

- an idea made manifest
- the creation/embodiment of something new
- the first occurrence of an idea for a new product or process
- *is the conversion of cash into ideas*

### INNOVATION

- an idea applied successfully in practice
- is the conversion of ideas into cash

*(Etymological origin of word INNOVATION – creation of something new)*

# Invention vs. Innovation

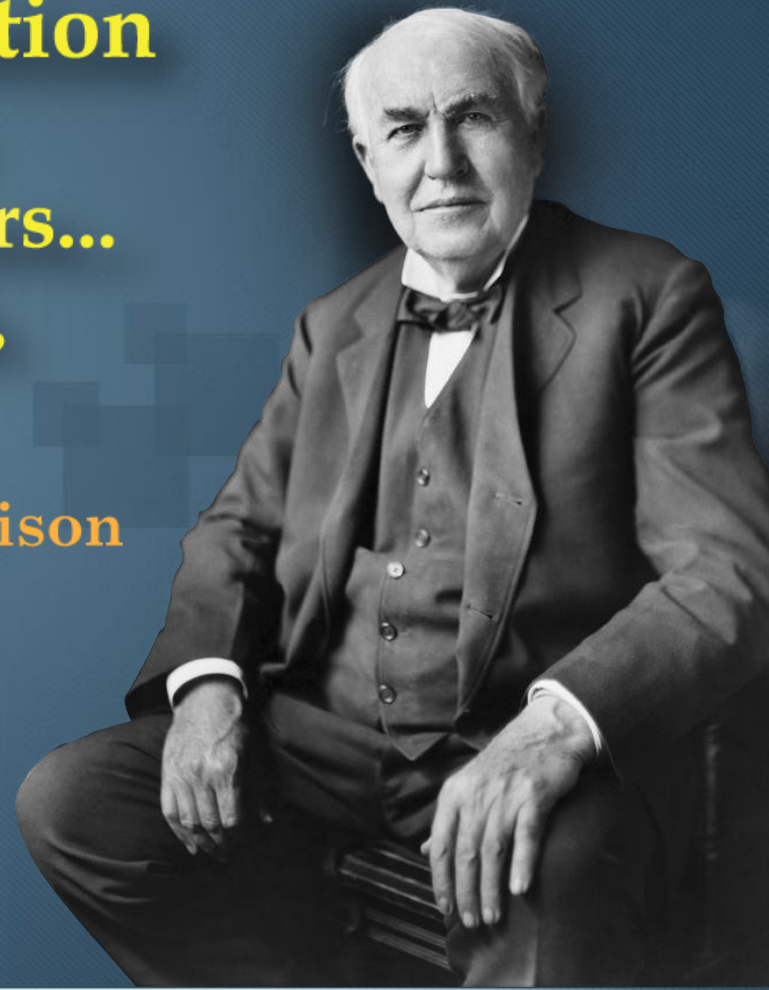
**Innovators** produce, market and profit from their innovations



**Inventors** may or may not profit from their inventions

“ I never perfected an invention  
that I did not think about in terms of the  
service it might give others...  
I find out what the world needs,  
then I proceed to invent. ”

– Thomas Edison





# 3. Sources of Innovation

## ➤ Inventor(s) –driven

- Recent research suggests that the most successful innovation occurs at the boundaries/interfaces

**A food for thought !!**

## ➤ End- User –Driven

- Need-based
- Increasingly assuming more importance

# Linear vs. Non-linear Innovation



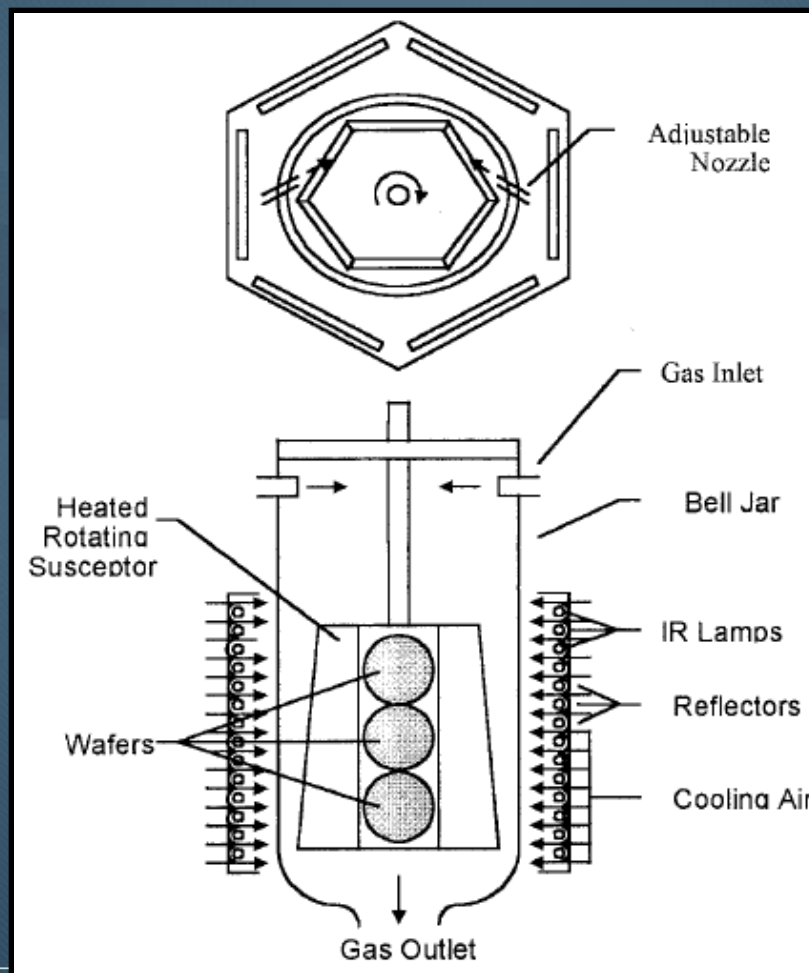
## 4. Innovation concepts: Linear vs. Non-linear Innovation

### □ Linear

- Incremental  
Ex: Cost reduction

➤ **Barrel reactor silicon epitaxy**

# CVD: Barrel Reactor



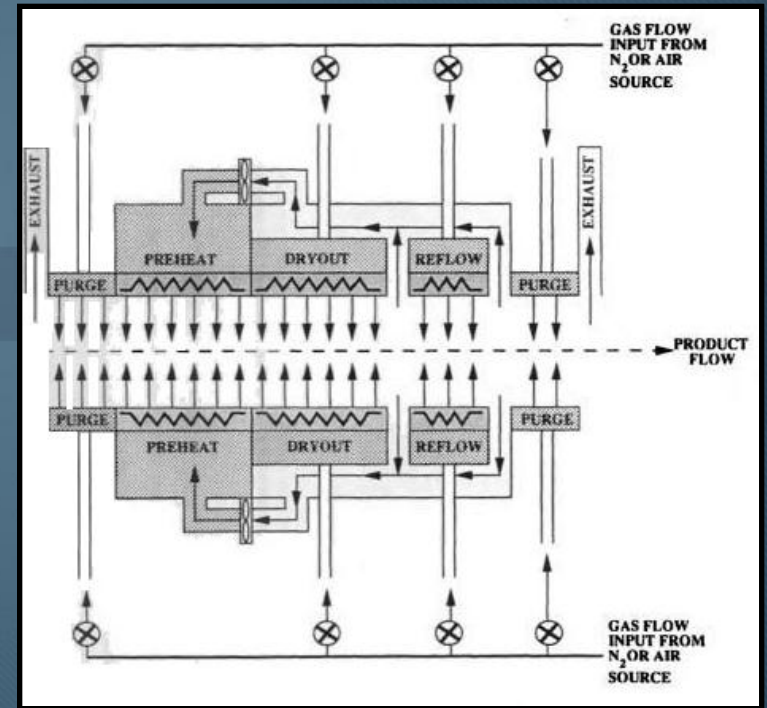
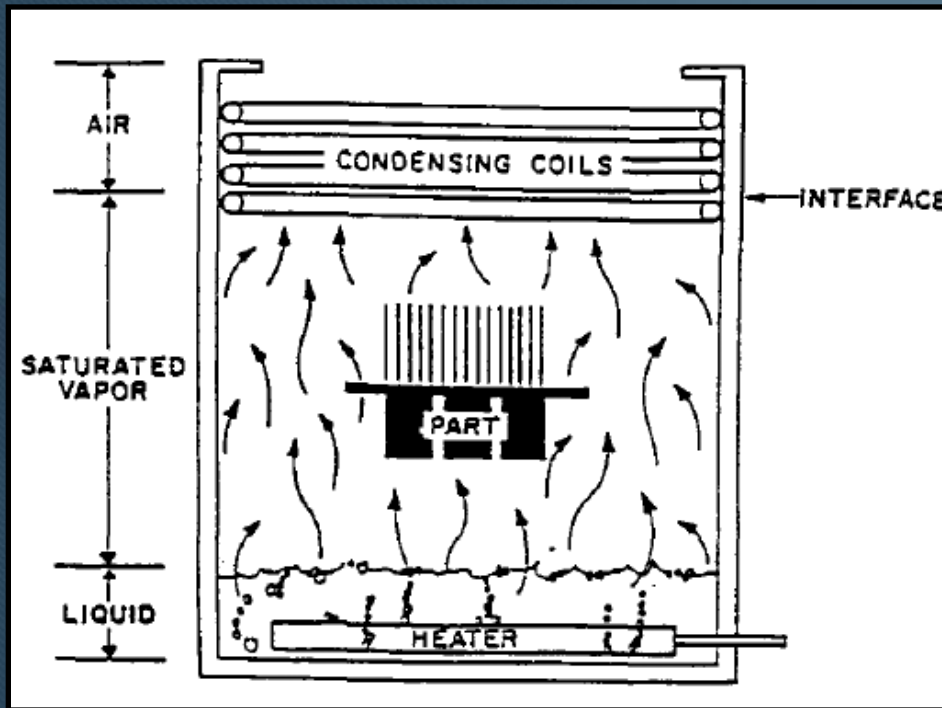
- **Non-linear innovation**
  - **Significant Impact**
  - **Impact generally in a single field**

**EX: Digital vs. analog watches**

- **Condensation Soldering vs. IR soldering**



# Condensation and IR Reflow Soldering



## 5. Innovation concepts: Black Swan Innovation

We have discussed so far

- Linear Innovation
- Non-linear and significant
- How about Extreme Impact, Game changer , pervasive innovation ?

In other words,

**How about a Black Swan ?**

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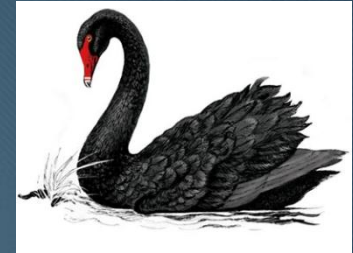
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# A Black Swan

A **Black Swan** is an event that has three characteristics;

- it is an outlier
- it carries an **extreme** impact
- it has retrospective predictability.



"The Black Swan", by Nassim Nicholas Taleb

- Our world is dominated by Black Swans.
  - the internet
  - the computer
  - the laser

*All three were unplanned, unpredicted, and unappreciated upon their discovery, and remained unappreciated well after initial use.*

# Innovation with extreme impact

Given the definition of Black Swan, a question to ponder:

can we predict the next black swan?



## My take

- we can definitely become a breeding ground for the next black swan
  - My experience at Bell Labs and at VT- ICTAS

# Bell Labs Experience

- A powerful exercise

WHAT WILL MAKE YOU  
UNEMPLOYABLE IN 7 YEARS?

Or

WHAT WILL MAKE YOU IRRELEVANT  
IN 7 YEARS?

- Bell Labs

- 8 Nobel prize winners
- One patent awarded/day (avg.) in the history of Bell Labs
- my own department –among the top three



# ICTAS and Black Swan



# ICTAS

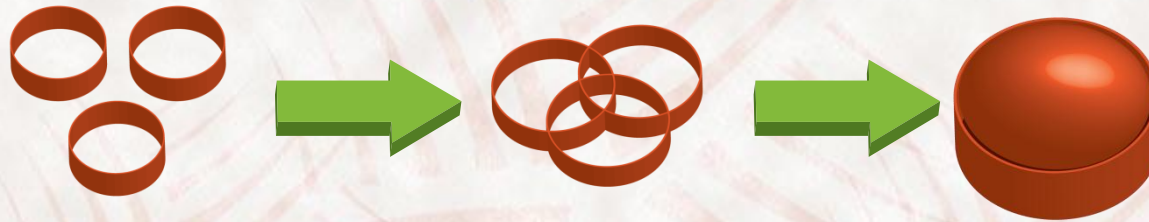
INSTITUTE *for* CRITICAL TECHNOLOGY  
*and* APPLIED SCIENCE *Virginia Tech*

To be among the top-rated institutes globally  
in transformative, sustainable technologies geared  
toward societal needs.



## 1. ICTAS acts a catalyst for Interdisciplinary Research

- *At the intersection of Engineering & the Sciences—physical, life and social – and the Humanities*

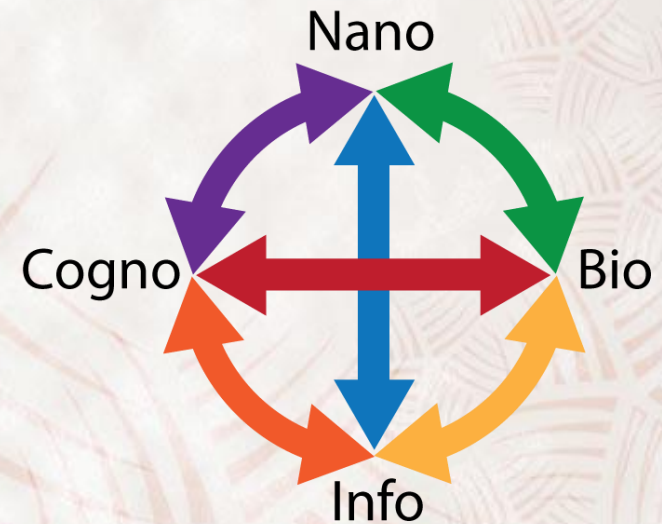


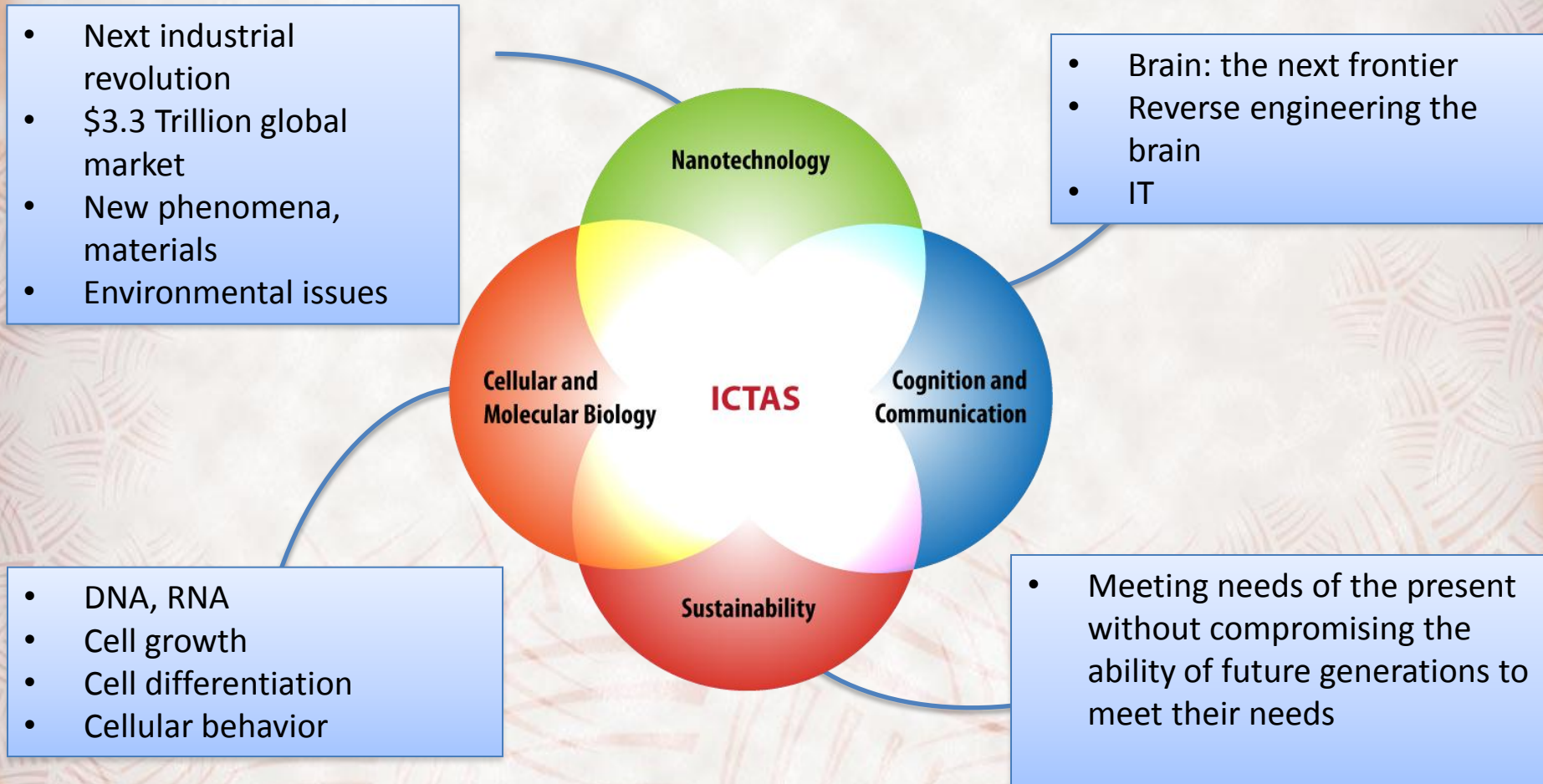
*“Buds of creativity bloom at intersections.” mahajan*



## 2. ICTAS is dedicated to cutting edge research at the confluence of transformative technologies

Each of these technologies has tremendous potential for impacting our lives





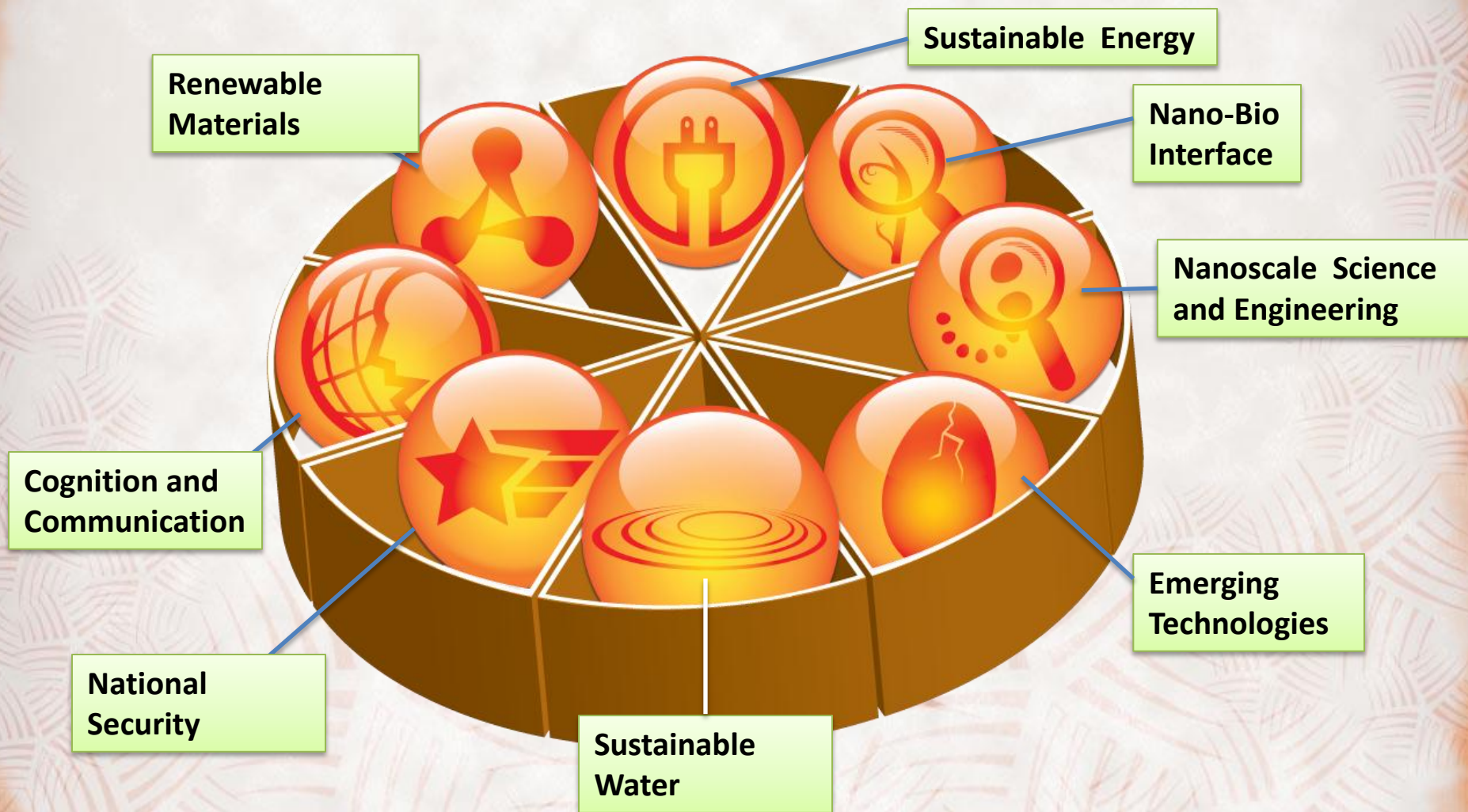


### 3. ICTAS research is about innovation.

- **A healthy dose of blue-skies component**
- **Is faculty-centric**
- **IT IS ALSO ABOUT THE NEXT BLACK SWAN!**







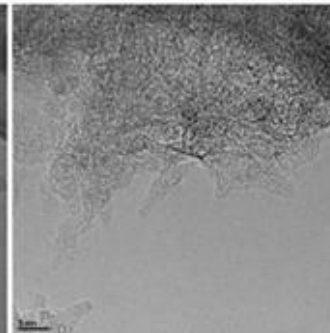
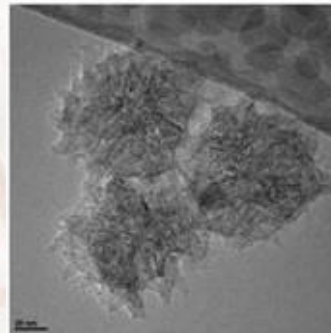
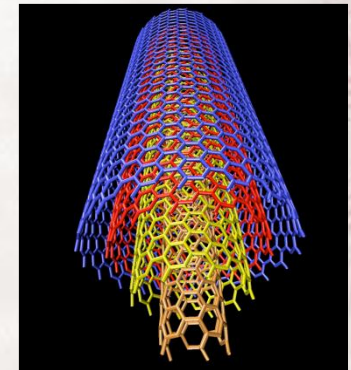
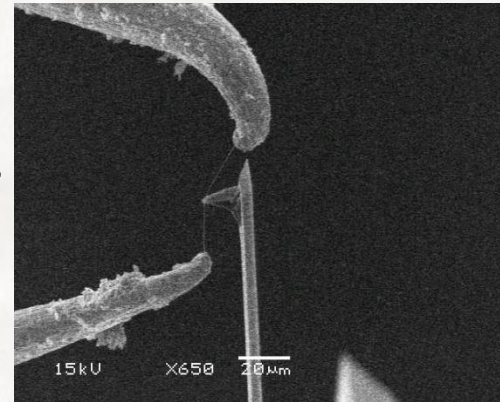
## 4. ICTAS research is designed for non-linear growth and a dominant position in the field.

- **Among the top three**





- Environmental Nanoscience and Technology
- Nanomaterials including carbonaceous materials
- Nanosensors
- Nanodevices

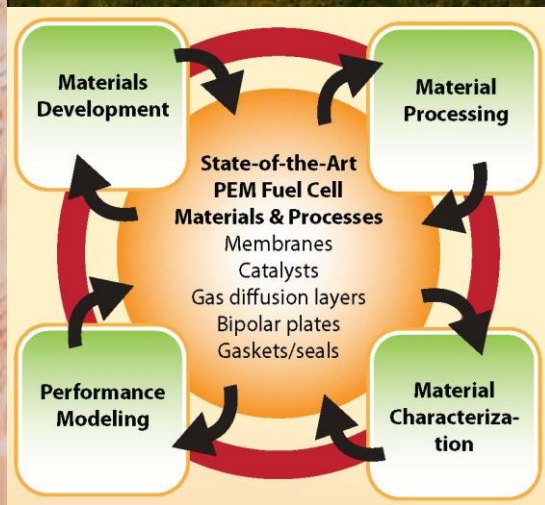
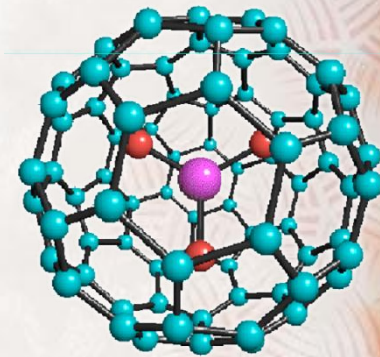




*Technology to meet society's energy needs – renewably and responsibly*

## Principal areas of research

- *Cleaner more efficient energy conversion systems*
  - *Fuel cells*
- *Renewable energy resources*
  - *Solar*
    - *Organic Photovoltaic cells*
    - *Multi-junction solar cells*
    - *Wind energy*
  - *Bio-fuels*
  - *Energy harvesting*
    - *NSF-I/UCRC Center for Energy Harvesting Materials And Systems (CEHMS)*







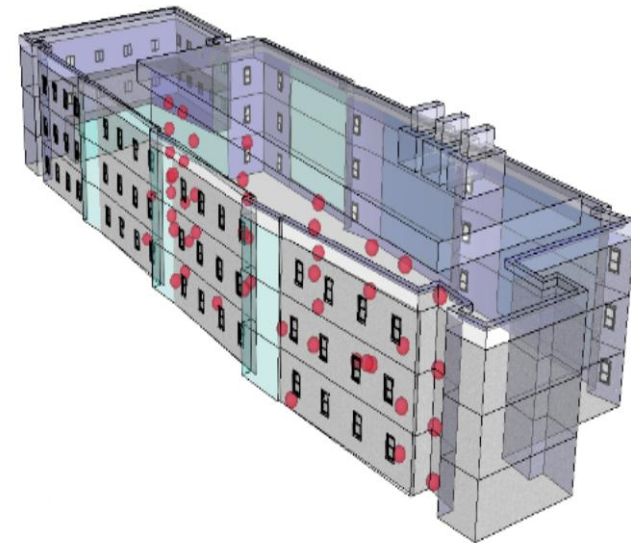
Poultry litter bio-oil

## Cognitive Radio Networks

- Physical radio testbed deployed throughout the ICTAS building
- Total nodes 48; nodes; 12 nodes per floor
- No restrictions on other wireless systems inside building
- Unique testbed with incredible potential for wireless

- Antennas and Propagation
- Secure Communications
- Wireless and Social Networks
- Signal Processing
- RF/VLSI Circuit Design

- Human Computer Interface





- **IDIQ with Dahlgren**
- **Ground Unmanned Support Surrogate (*GUSS*)**
  - A “flagship” project with NSWC Dahlgren for Marine Corps War-fighting Lab.
  - Four Vehicles participated in Rim of Pacific (RIMPAC) Exercise 2010
  - Operated by Marines
  - Significant Press Interest



*“GUSS surprised everybody with its growth and technological capability.”*

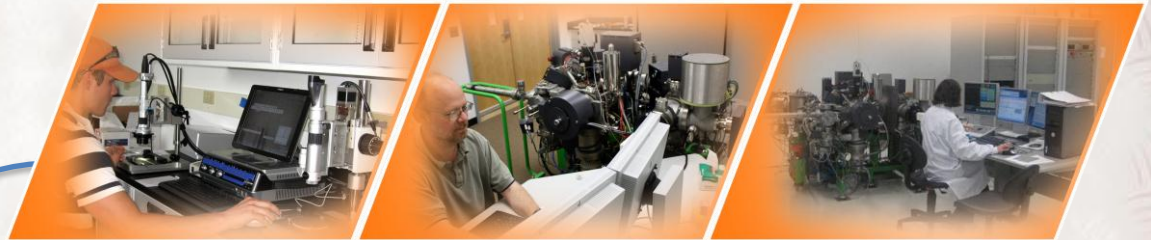
*-Vince Goulding, Director*

*Experiments Division Marine Corps War fighting Lab*

- **Autonomous Vehicles**
- **Sensor and sensor fusion**
- **Cyber Security**

- **Modes of operation**
  - GPS/Waypoint Sight
  - “Follow Me”
  - Drive by Wire
  - Manual





ICTAS HQ



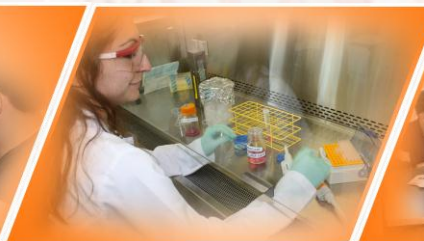
ICTAS CRC



ICTAS LSC

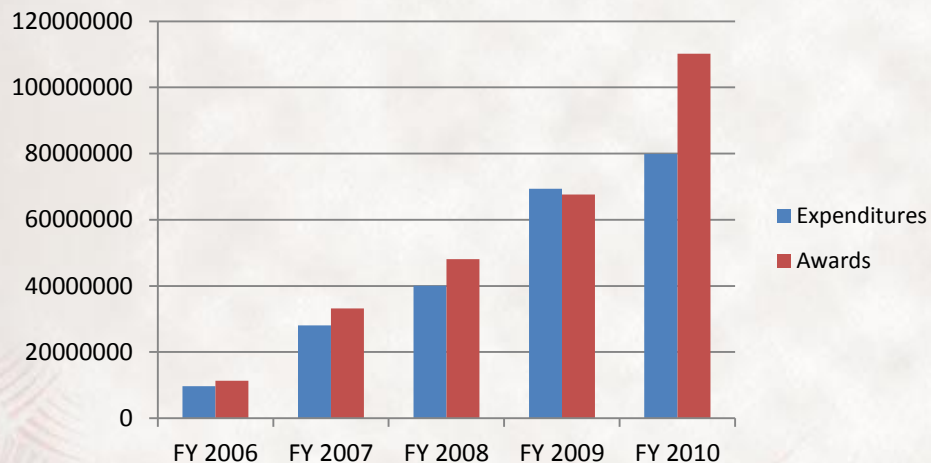


ICTAS NCR



VT, India ?

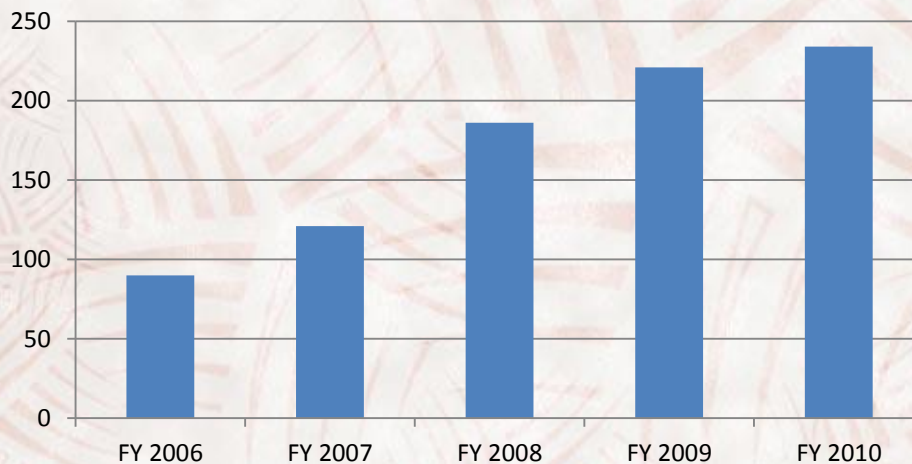
## Expenditures and Awards



### Budget

FY 07	\$4.0 M
FY 08	\$5.7 M
FY 09	\$8.1 M
FY 10	\$7.7 M
FY 11	\$ 7.7 M

## Number of Faculty Supported



FY10

Ph.D. Students supported: 136

ICTAS Doctoral Scholars: 40





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# Dahlgren: A potential breeding ground for Black Swans

- A track record of
  - Technical competency
  - Innovation

“Dahlgren has become the “crown jewel” of the Navy’s Warfare Centers, the intellectual capital for the Navy’s combat systems, and the enabler for the Navy’s technological superiority”



# Dahlgren: A potential breeding ground for Black Swans

- ❑ Maintaining superiority in a hyper- Schumpeterian and hyper-connected world a challenging task.
  
- ❑ But
  - We, as a nation, have a culture of innovation, risk taking
  - We also have a tradition of partnership between academia and Dahlgren
  
- ❑ What Dahlgren needs to do
  - is to accelerate the pace and scope of innovation to maintain its crown jewel status.
  - Become a successful breeding ground for the next Black swans

# Dahlgren: A successful breeding ground for extreme innovation

1. Technical competency

2. An environment in which out-of-the-box thinking can prosper

- promoting interdisciplinary research

**Buds of creativity bloom at intersections**





# A successful breeding ground

## 3. Risk-taking is encouraged

- Celebration of successes
- A safety net for “risk-takers”



# A successful breeding ground

## 4. Existing paradigms are constantly examined

- Initiate Black swan seminars at Dahlgren or lead these seminars at VT

**WHAT WILL MAKE YOU  
UNEMPLOYABLE IN 7 YEARS?**

Or

**WHAT WILL MAKE YOU IRRELEVANT  
IN 7 YEARS?**



# Dahlgren: A potential breeding ground for Black Swans

- ❑ We are your partners in this.
- ❑ We can help bring the two esteemed organizations together
- ❑ We can bring inventors and innovators together
- ❑ We can be a catalyst for Dahlgren staying ahead of the competition in maintaining the Navy's technological superiority for the Navy's combat systems.
- ❑ **We can build a bridge to a bright and sustainable future, one span at a time....**

Together, we will build a bridge to a  
bright future

**Dream !**

**Excel !**

**Build a sustainable future !**

