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
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?
“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
Innovation Concepts

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

Diagram showing a barrel reactor with labels for adjustable nozzle, gas inlet, bell jar, heated rotating susceptor, wafers, IR lamps, reflectors, and cooling air.
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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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
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.
• Next industrial revolution
• $3.3 Trillion global market
• New phenomena, materials
• Environmental issues

• DNA, RNA
• Cell growth
• Cell differentiation
• Cellular behavior

• Brain: the next frontier
• Reverse engineering the brain
• IT

• Meeting needs of the present without compromising the ability of future generations to meet their needs
3. ICTAS research is about innovation.

- A healthy dose of blue-skies component
- Is faculty-centric

IT IS ALSO ABOUT THE NEXT BLACK SWAN!
Research Thrusts

- Nanoscale Science and Engineering
- Nano-Bio Interface
- Sustainable Energy
- Nanoscale Science and Engineering
- Emerging Technologies
- Sustainable Water
- National Security
- Cognition and Communication
- Renewable Materials
ICTAS Research

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
Sustainable Energy

**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
Cognition and Communication

- 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
Infrastructure

ICTAS HQ
ICTAS CRC
ICTAS LSC
ICTAS NCR

VT, India
Expenditures and Awards

Number of Faculty Supported

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

FY 10
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

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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!