Intersections, Creativity and Black Swans

Tea and Talk
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“Creativity blooms at the boundaries between intersections”
mahajan

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What Does it Mean to be Creative?

- New or different viewpoints on a subject
- Breaking down and restructuring our knowledge about the subject in order to gain new insights into its nature
- Create new things – Invent or innovate
What Does it Mean to be Creative?

**Logical Thinking** – Series of steps, each dependent on the last, this type of thinking is just an extension of what we already know.

1 + 2 = 3

**Creative Thinking** – Allows people to use their imagination and invent/innovate new things

Internet + Shopping = eBay
What is Innovation?

How is Innovation different from Invention?
INVENTION

• an idea made manifest
• the creation/embodiment of something new
• the first occurrence of an idea for a new product or process

INNOVATION

is an invention/idea applied successfully in practice
“Innovation is not the product of logical thought, although the result is tied to logical structure.”
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
Why is there so much emphasis on creativity/invention/innovation?
Innovation - the 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?

*PBS Documentary, narration by Alan Alda
“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
1. Linear Innovation
   - Incremental
     - Cost reduction
     - Product/service extensions
CVD Barrel Reactor

From two to three rows of wafers

Example from my world at Bell Labs
1. **Linear Innovation**
   - Incremental
     - Cost reduction
     - Product/service extensions

2. **Non-linear Innovation**
   - Out-of-the box, big impact
   - Generally limited to one or few fields
Condensation and IR Reflow Soldering

Example from my world at Bell Labs
Other Examples of non-linear inventions

1970: Fiber optics

1971: Magnetic resonance imaging: Raymond V. Damadian

1972: Computed Tomography: Godfrey Newbold Hounsfield


1974: Heimlich Maneuver: Henry Heimlich

1975: digital camera: Steven Sasson

1978: Philips releases the laserdisc player

1979: the Walkman: Akio Morita, Masaru Ibuka, Kozo Ohsone

1979: the cellular telephone (first commercially fielded version, NTT)

Source: antimisandry.com
Levels of Innovation

1. Linear Innovation
   - Incremental
     - Cost reduction
     - Product/service extensions

2. Non-linear Innovation
   - Out-of-the box, big impact
   - Game-changer, huge impact; generally limited to one or few fields

3. Black Swan/Disruptive Innovation
   - Huge and broad impact
   - Element of unpredictability
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.
“The disproportionate role of high-impact, hard to predict, and rare (?) events that are beyond the realm of normal expectations in history, science, finance and technology.”

Wikipedia

- The real estate melt down/collapse of the stock market in late 2008
- "Arab Spring", January 2011
- Earthquake/tsunami/ and nuclear accident in Japan, March 2011
How do intersections promote creativity/innovation - linear, non-linear and Black Swan?
Bringing researchers from different disciplines opens door for questions beyond the well-trodden grooves

Simple questions asked of experts from outside the field can give rise to new ideas; free flow of information, egos unlikely to play a big role

Examples
- MEDICA (U. Colorado, Boulder)
  - Cardiac Assist Device. A new company spin-off
    - To distinguish innocent from pathological heart murmurs in children -
Personal biomonitor using ANN Classifier
Black Swan Seminar Series

Held in Café X, ICTAS Lobby
An informal discussion of the future

WHAT WILL MAKE YOU IRRELEVANT IN 7 years?

• No tyranny of power point
• A lead person initiates discussion
• Attendees from different disciplines
• Ideas are generated
  ○ Cygnets—baby swans

• Follow-up
  ○ Some die—Infant mortality
  ○ Some grow—new area(s) of research
    ▪ Bio-inspired cyber security
  ○ Breeding ground for the next black swan!!
Story of Diana Dabby

--Electrical engineering &
music professor at Olin College

Artscience by David Edwards
One more story—when math & painting came together—Julio Ottino, Dean, Engineering, NW

The art of mixing with an admixture of art: Fluids, solids, and visual imagination
Julio M Ottino

Physics of fluids, 22 (2010)
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.
• 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 designed for non-linear growth and a dominant position in the field.

- Among the top three
4. ICTAS research is about innovation.

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