

# Intersections, Creativity and Black Swans

*Tea and Talk*  
May 9, 2013



“Creativity blooms at  
the boundaries  
between intersections”  
mahajan



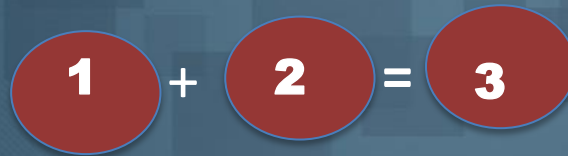
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## **□ What Does it Mean to be Creative?**

- **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.



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



**□ What is Innovation?**

**□ How is Innovation  
different from  
Invention?**

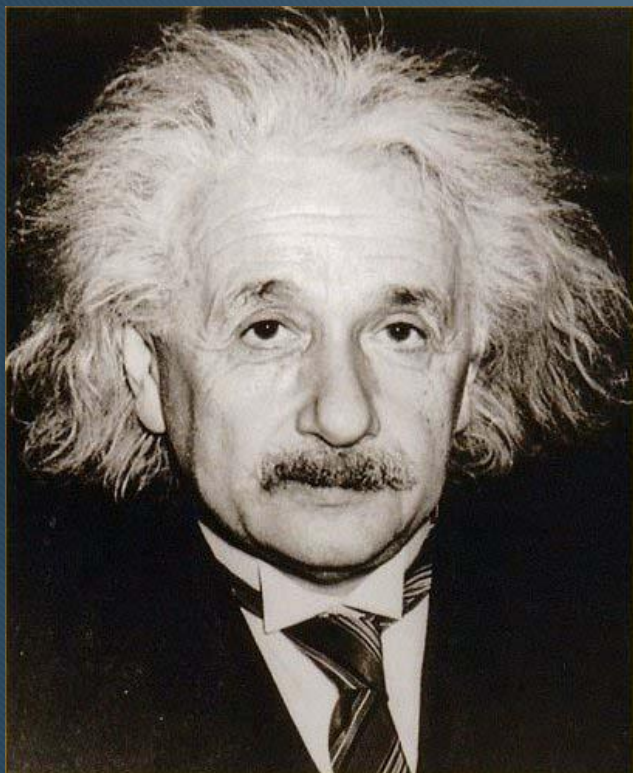
# ***Invention and Innovation***

## **INVENTION**

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

## **INNOVATION**

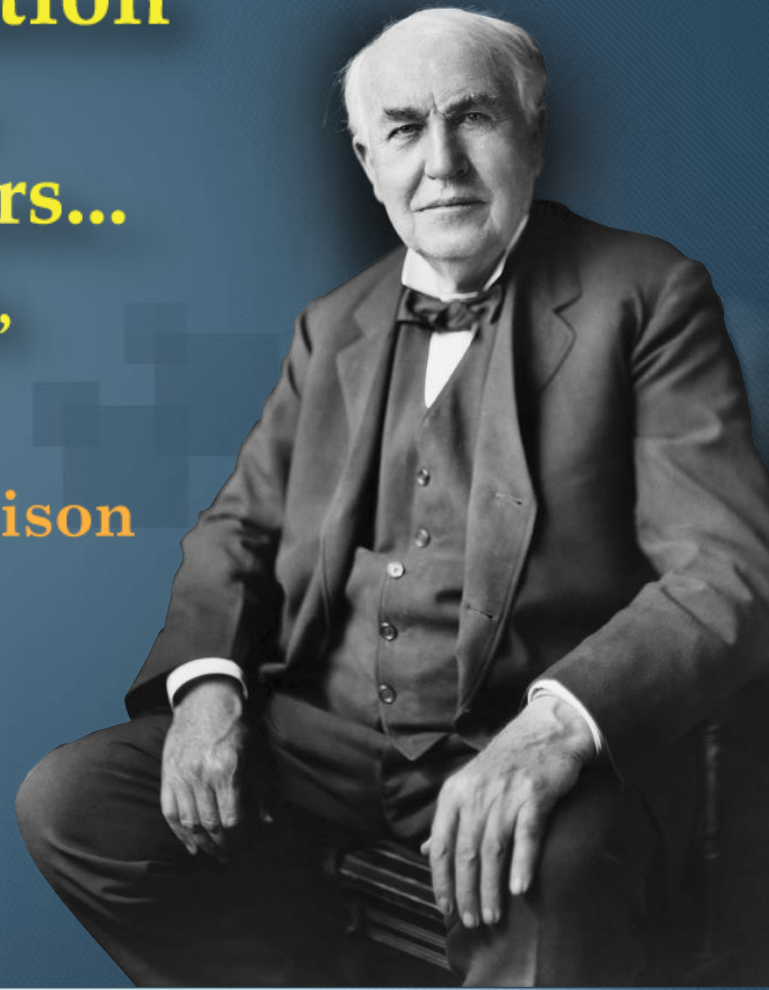
is an invention/idea applied successfully in practice



**“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?**



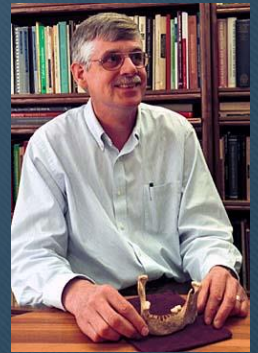
# *Innovation- the Human Spark\**

- **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*



# ***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**

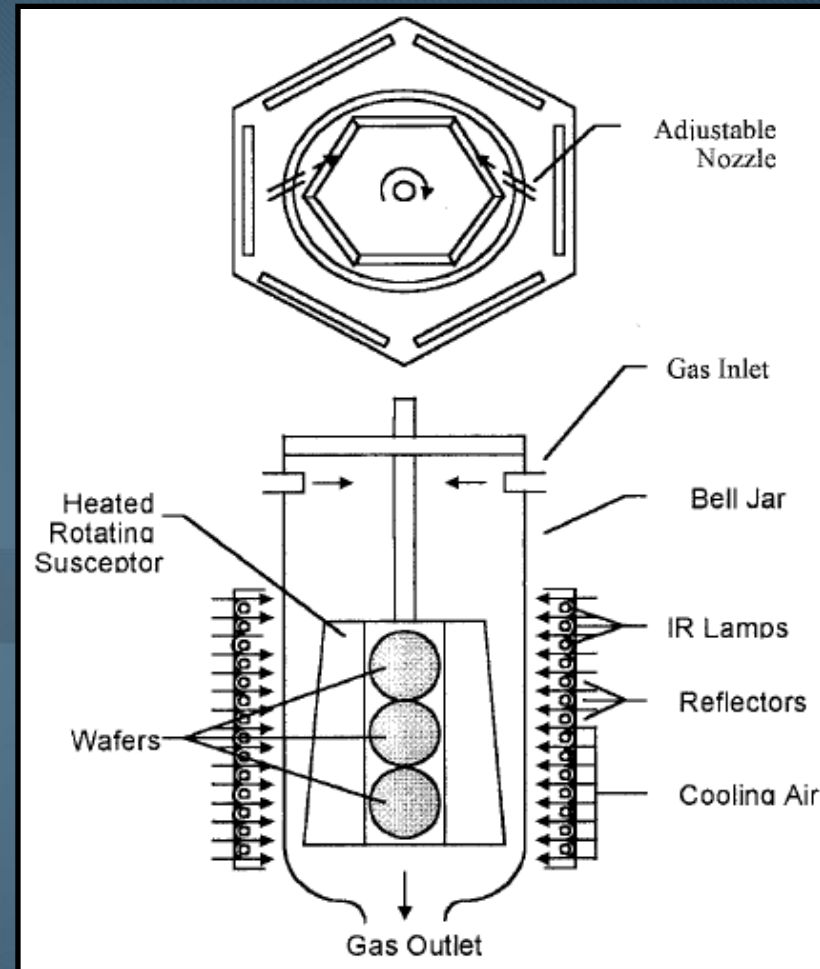
**Marketing Guru, Harvard Business School**

## **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

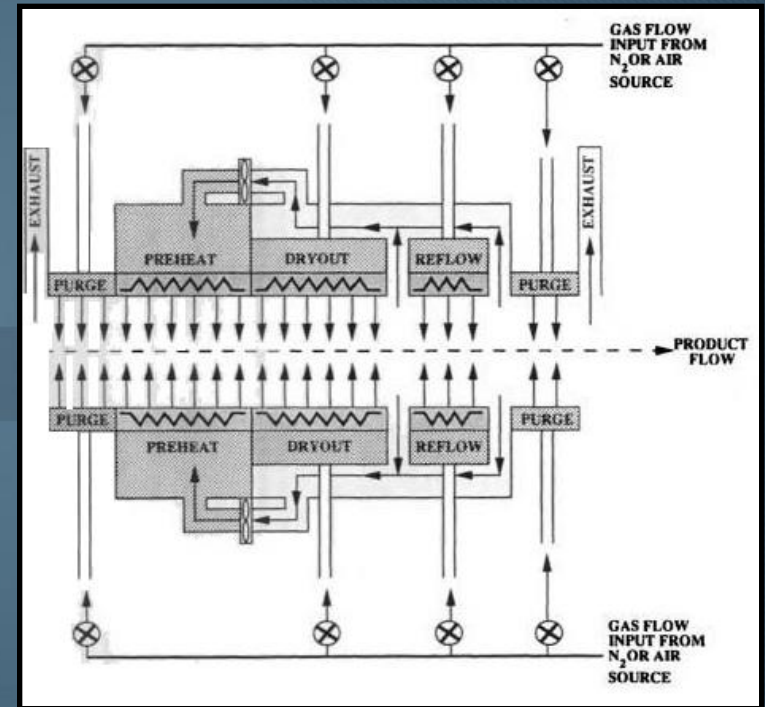
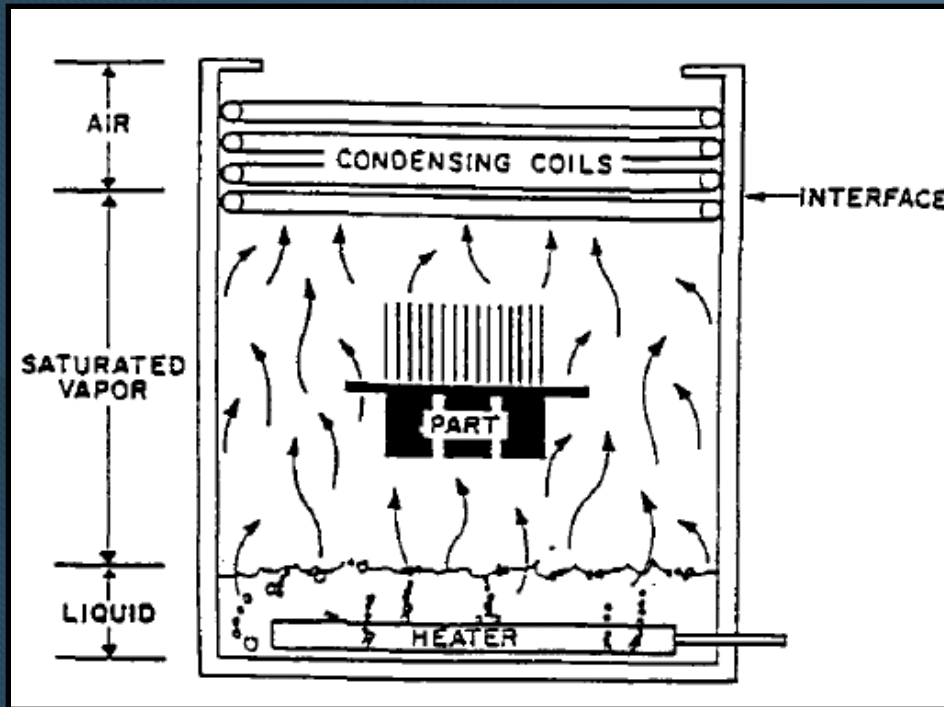
## **1. Linear Innovation**

- 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**

**1973: Monash U. scientists report the world's first IVF pregnancy.**

**1974: Heimlich Maneuver: Henry Heimlich**

**1975: digital camera: Steven Sasson**

**1978: Philips releases the laserdisc player**

**1979: the Walkman: Akio Morita, Masaru Ibuka, Kozo Ohsonoe**

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

*Source: [antimisandry.com](http://antimisandry.com)*

## 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

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.”

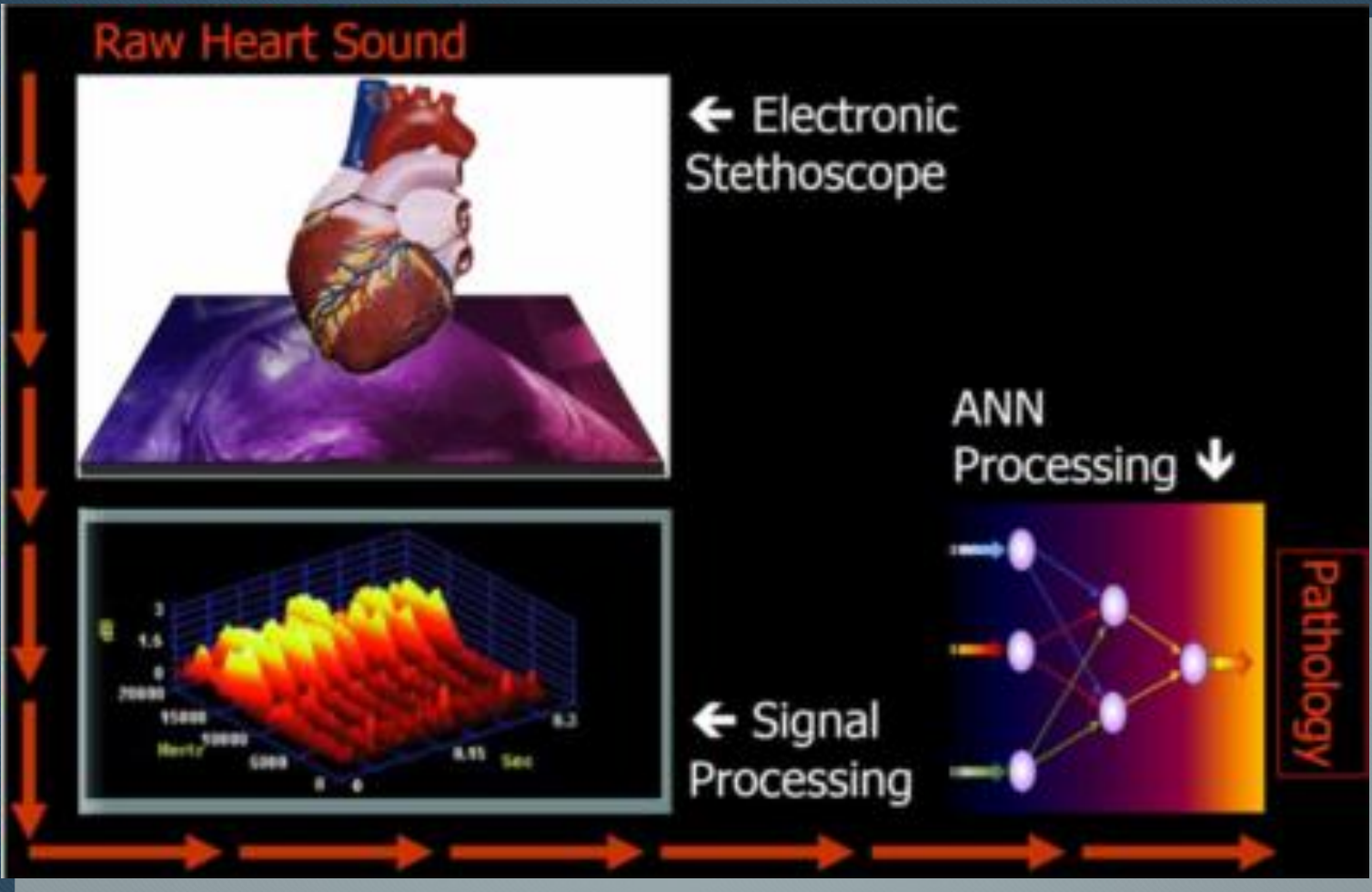
Wikipedia

- **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?**

# ***Intersections & Innovation***

- **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 bimonitor  
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?**

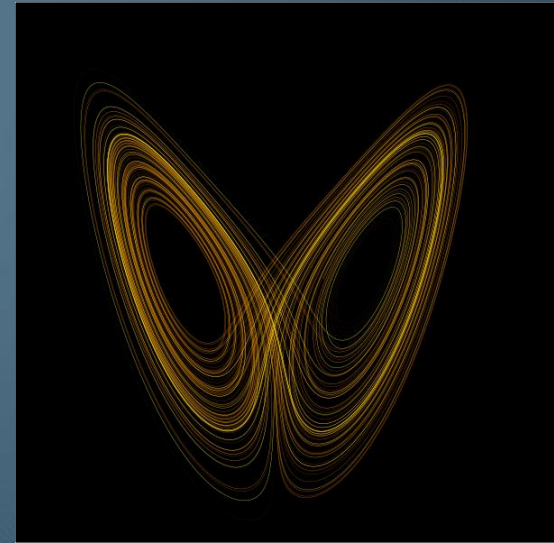
- **No tyranny of power point**
- **A lead person initiates discussion**
- **Attendees from different disciplines**



- 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**



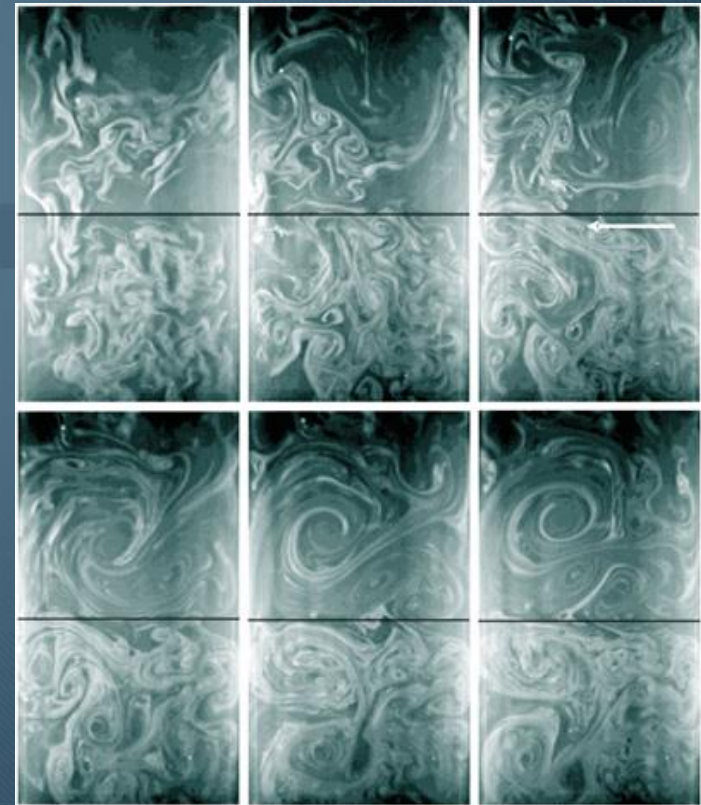
**Artscience by David Edwards**



□ **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)**



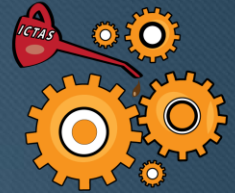


# ICTAS

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



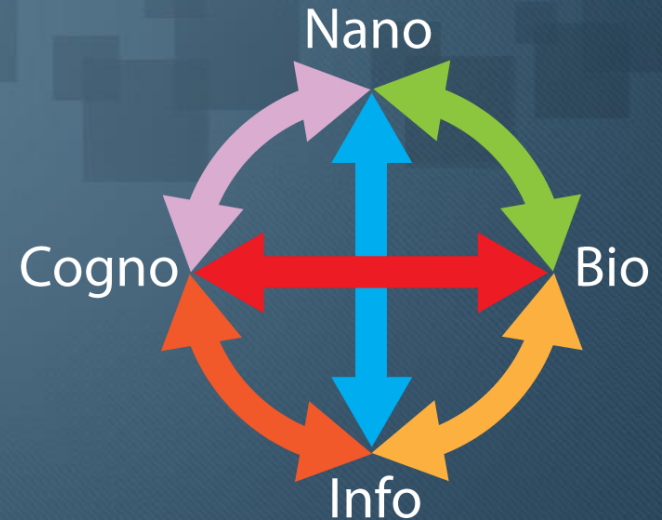
- ***At the intersection of Engineering & the Sciences—physical, life and social – and the Humanities***



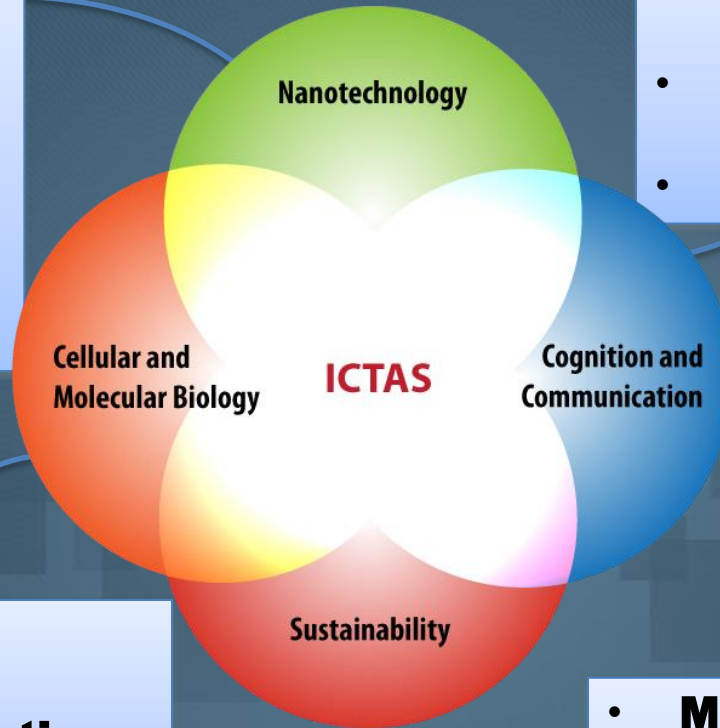
“Buds of creativity bloom at intersections.” mahajan

## 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**



- **Next industrial revolution**
- **\$3.3 Trillion global market**
- **New phenomena, materials**
- **Environmental issues**



- **Brain: the next frontier**
- **Reverse engineering the brain**
- **IT**

- **DNA, RNA**
- **Cell growth**
- **Cell differentiation**
- **Cellular behavior**

- **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!



