TECHNOLOGY AND ENGINEERING

LEVERAGING *PHENOMENA** FOR *USEFUL* PURPOSES**

- **PHYSICAL** (e.g. Photoelectric Effect)
- **CHEMICAL** (e.g. Catalysis)
- **GEOLOGICAL** (e.g. Groundwater)
- **BIOLOGICAL** (e.g. Bioengineering)
- ***SOCIAL-BEHAVIORAL***

Increasing complexity

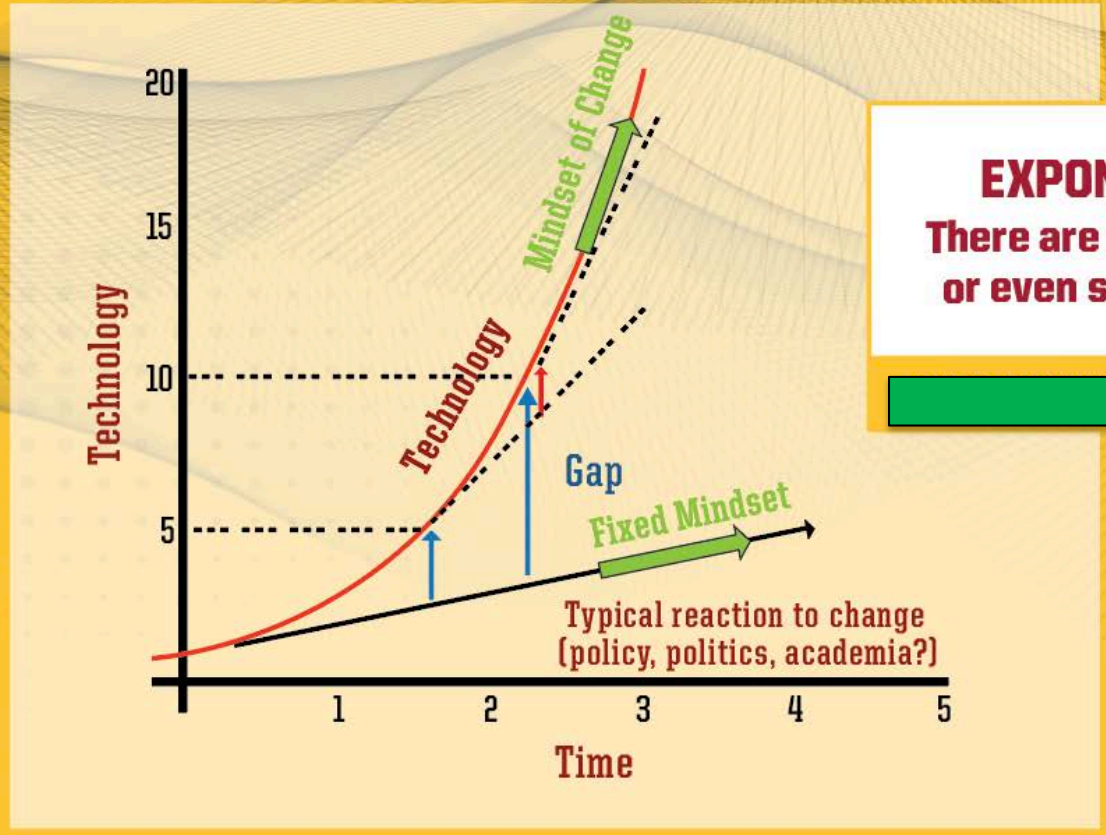
Convergence

Paraphrased from Brian Arthur (2008)

**And systems, devices and tools- and combinations thereof*
Including the **discovering of new phenomena

FAST GROWING TECHNOLOGY: ERA OF CONSTANT ACCELERATIONS (FRIEDMAN, 2016)

Materials, Energy, Knowledge: Only the latter has the property that the more it is consumed the more is created (not my remark)



EXPONENTIAL CHANGES

There are no longer steady states or even steady states in growth

Exponential, if the technology speed is proportional to it

$$\frac{\Delta A}{\Delta t} \approx \lambda A$$

Faster than exponential (*singularity*) if it is proportional to a higher power (n>1)

$$\frac{\Delta A}{\Delta t} \approx \lambda A^n$$

Convergence

ENGINEERING + X

Where X is anything*!

E.g. Media, Medicine, Entertainment, Biology, Education,…

Three pathways:

E => X (Engineering Empowers X)

X => E (X empowers Engineering)

EUX (Engineering and X comingle)

E and X can be vectors

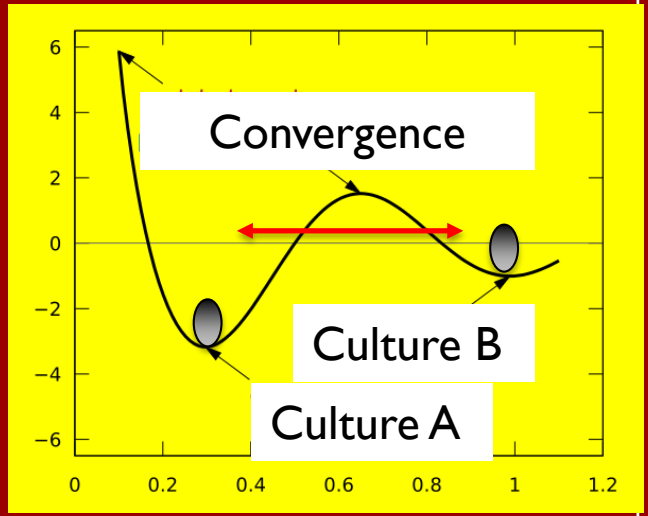
**Increasingly human-centric*

USC Viterbi
School of Engineering

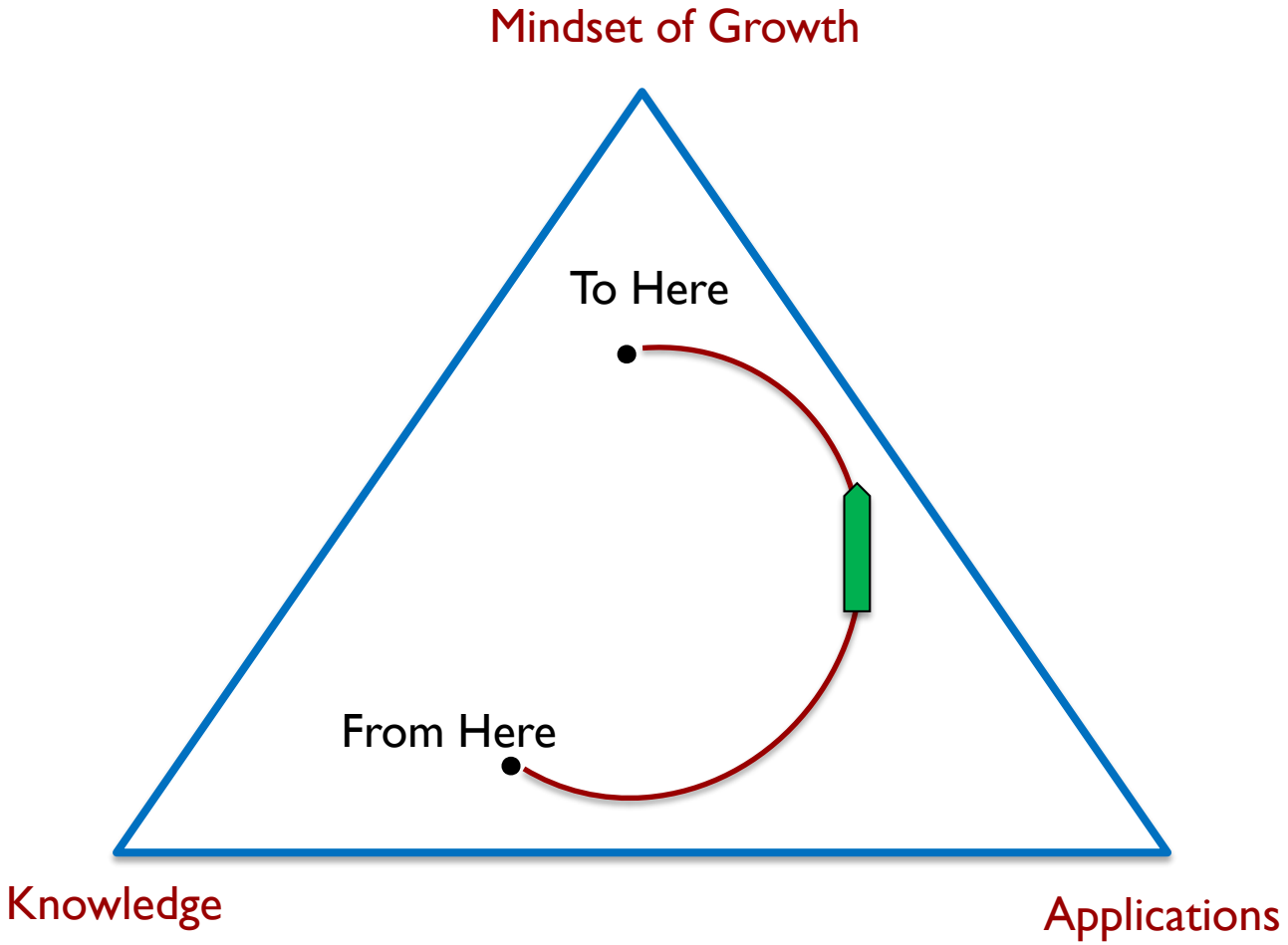
CONVERGENCE CHALLENGES

"Culture wants to be enduring and prevailing"

from Antonio Damasio's "The strange world of things" (2018)



Skills and Knowledge (+ Mindsets)



From Ortiz et al.

EXPONENTIAL TECHNOLOGY BRINGS DISRUPTION REQUIRES AGILITY AND ADAPTABILITY – AND *NEW MINDSETS*

THE FIVE MINDSETS OF CHANGE TO THRIVE IN TODAY'S WORLD

And to Solve Grand Challenges

1. **HUG THE EXPONENTIAL**
   Superb Technical Skills and Knowledge to Lead the Exponentially Changing Technology

2. **ENGINEERING +: CHANGE THE CONVERSATION ABOUT ENGINEERING**
   Engineering + X where X is anything (particularly, human-centric)
   Who we are, what we do and what we look like.

3. **INNOVATION IN THE BROADEST SENSE**
   Innovation and Entrepreneurship, to help create the new markets,
   the new jobs and to design the new self.

4. **THE CULTURAL MIND**
   Cultural Awareness (with culture broadly interpreted), to help thrive in
   today's fast changing world.

5. **HEROIC ENGINEERING**
   Awareness of the Impact of Engineering to Society
   (and the importance of technology ethics).