Technology Convergence as a Driver of Innovation

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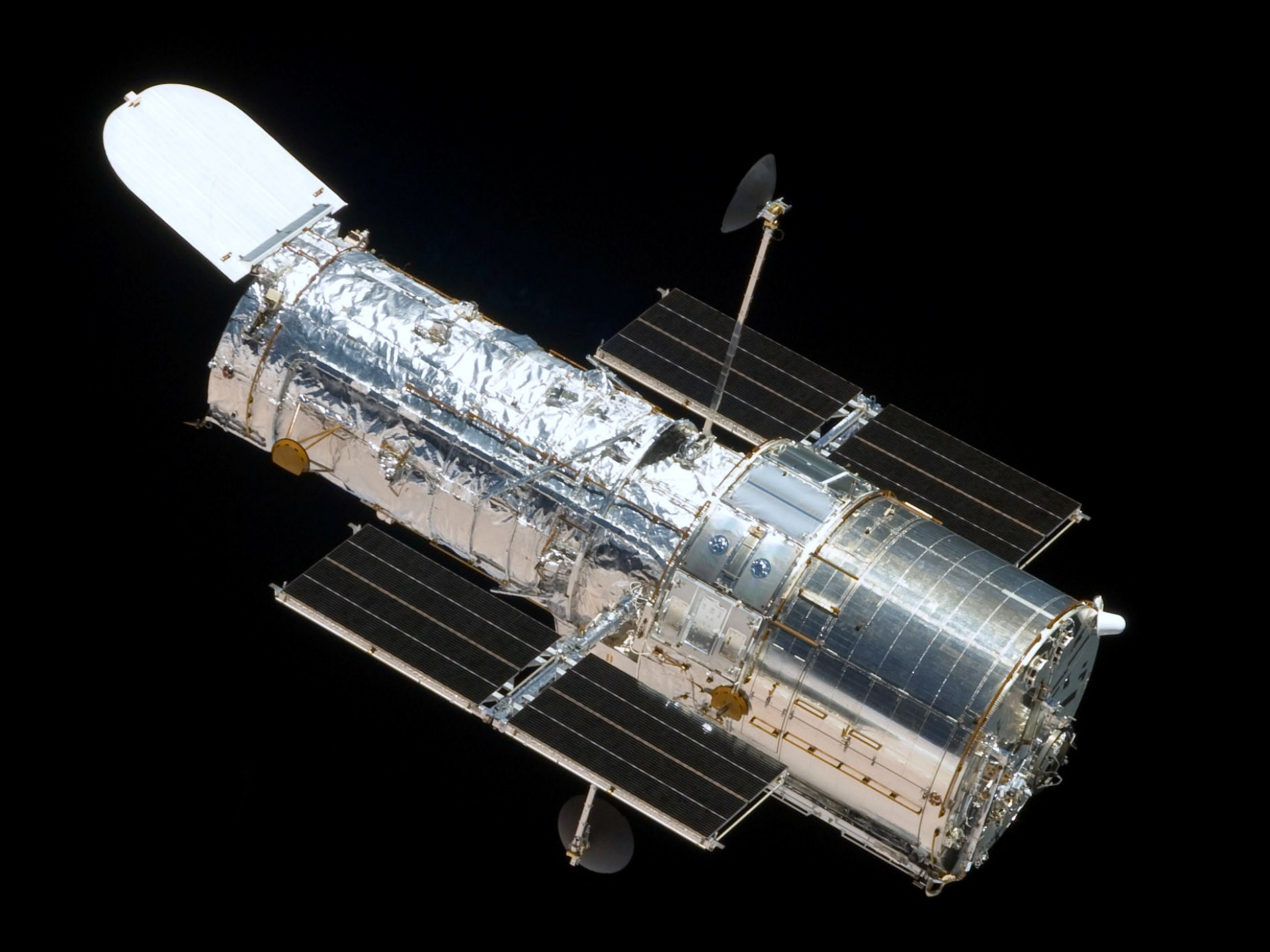
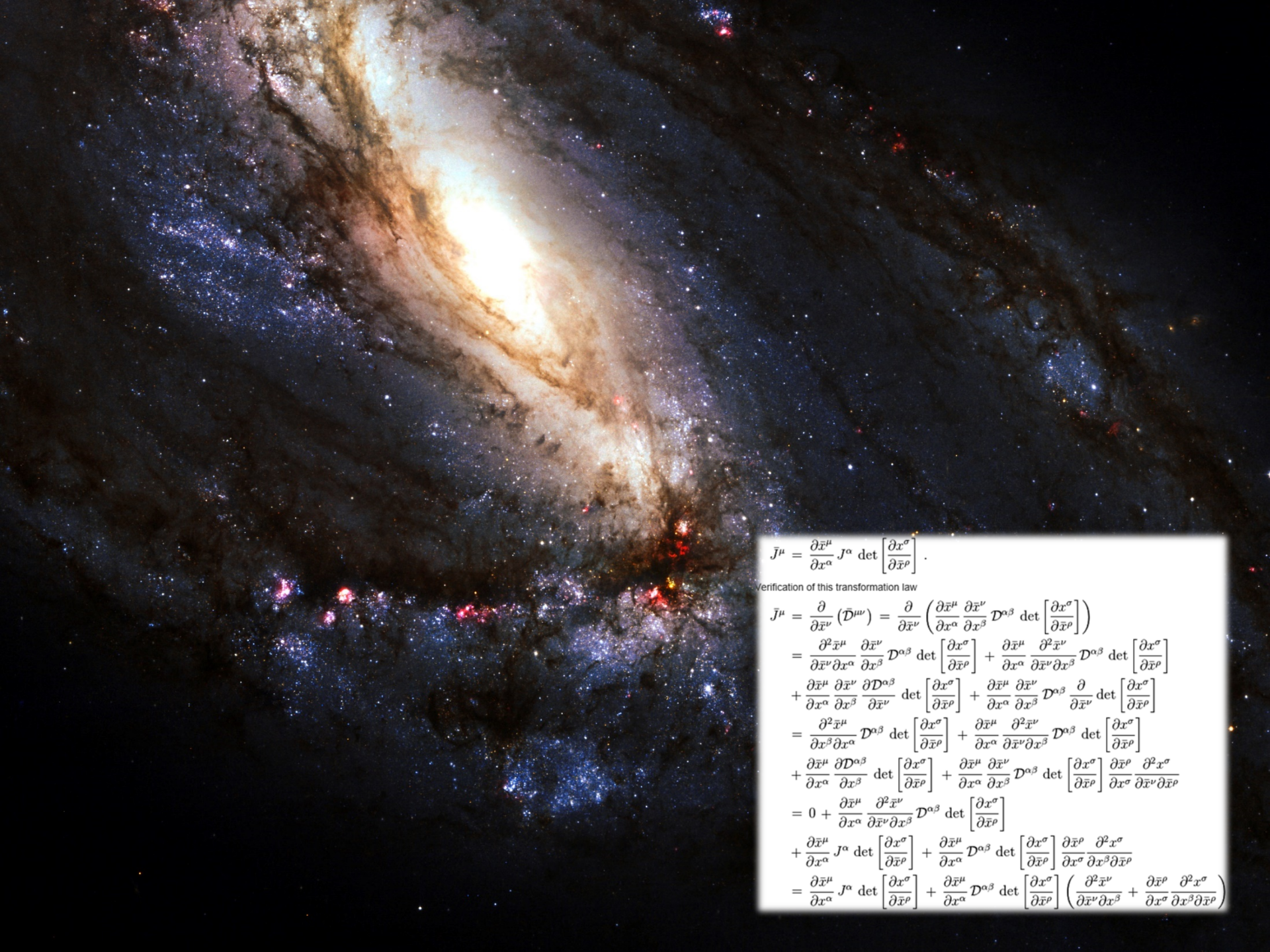
Information Technology





$$\bar{J}^{\mu} = \frac{\partial \bar{x}^{\mu}}{\partial x^{\alpha}} J^{\alpha} \det\left[\frac{\partial x^{\sigma}}{\partial \bar{x}^{\rho}}\right] .$$

Verification of this transformation law

$$\begin{aligned}
\bar{J}^{\mu} &= \frac{\partial}{\partial \bar{x}^{\nu}}\left(\bar{\mathcal{D}}^{\mu\nu}\right) = \frac{\partial}{\partial \bar{x}^{\nu}}\left(\frac{\partial \bar{x}^{\mu}}{\partial x^{\alpha}}\frac{\partial \bar{x}^{\nu}}{\partial x^{\beta}}\mathcal{D}^{\alpha\beta}\det\left[\frac{\partial x^{\sigma}}{\partial \bar{x}^{\rho}}\right]\right) \\
&= \frac{\partial^2 \bar{x}^{\mu}}{\partial \bar{x}^{\nu}\partial x^{\alpha}}\frac{\partial \bar{x}^{\nu}}{\partial x^{\beta}}\mathcal{D}^{\alpha\beta}\det\left[\frac{\partial x^{\sigma}}{\partial \bar{x}^{\rho}}\right] + \frac{\partial \bar{x}^{\mu}}{\partial x^{\alpha}}\frac{\partial^2 \bar{x}^{\nu}}{\partial \bar{x}^{\nu}\partial x^{\beta}}\mathcal{D}^{\alpha\beta}\det\left[\frac{\partial x^{\sigma}}{\partial \bar{x}^{\rho}}\right] \\
&+ \frac{\partial \bar{x}^{\mu}}{\partial x^{\alpha}}\frac{\partial \bar{x}^{\nu}}{\partial x^{\beta}}\frac{\partial \mathcal{D}^{\alpha\beta}}{\partial \bar{x}^{\nu}}\det\left[\frac{\partial x^{\sigma}}{\partial \bar{x}^{\rho}}\right] + \frac{\partial \bar{x}^{\mu}}{\partial x^{\alpha}}\frac{\partial \bar{x}^{\nu}}{\partial x^{\beta}}\mathcal{D}^{\alpha\beta}\frac{\partial}{\partial \bar{x}^{\nu}}\det\left[\frac{\partial x^{\sigma}}{\partial \bar{x}^{\rho}}\right] \\
&= \frac{\partial^2 \bar{x}^{\mu}}{\partial x^{\beta}\partial x^{\alpha}}\mathcal{D}^{\alpha\beta}\det\left[\frac{\partial x^{\sigma}}{\partial \bar{x}^{\rho}}\right] + \frac{\partial \bar{x}^{\mu}}{\partial x^{\alpha}}\frac{\partial^2 \bar{x}^{\nu}}{\partial \bar{x}^{\nu}\partial x^{\beta}}\mathcal{D}^{\alpha\beta}\det\left[\frac{\partial x^{\sigma}}{\partial \bar{x}^{\rho}}\right] \\
&+ \frac{\partial \bar{x}^{\mu}}{\partial x^{\alpha}}\frac{\partial \mathcal{D}^{\alpha\beta}}{\partial x^{\beta}}\det\left[\frac{\partial x^{\sigma}}{\partial \bar{x}^{\rho}}\right] + \frac{\partial \bar{x}^{\mu}}{\partial x^{\alpha}}\frac{\partial \bar{x}^{\nu}}{\partial x^{\beta}}\mathcal{D}^{\alpha\beta}\det\left[\frac{\partial x^{\sigma}}{\partial \bar{x}^{\rho}}\right]\frac{\partial \bar{x}^{\rho}}{\partial x^{\sigma}}\frac{\partial^2 x^{\sigma}}{\partial \bar{x}^{\nu}\partial \bar{x}^{\rho}} \\
&= 0 + \frac{\partial \bar{x}^{\mu}}{\partial x^{\alpha}}\frac{\partial^2 \bar{x}^{\nu}}{\partial \bar{x}^{\nu}\partial x^{\beta}}\mathcal{D}^{\alpha\beta}\det\left[\frac{\partial x^{\sigma}}{\partial \bar{x}^{\rho}}\right] \\
&+ \frac{\partial \bar{x}^{\mu}}{\partial x^{\alpha}}J^{\alpha}\det\left[\frac{\partial x^{\sigma}}{\partial \bar{x}^{\rho}}\right] + \frac{\partial \bar{x}^{\mu}}{\partial x^{\alpha}}\mathcal{D}^{\alpha\beta}\det\left[\frac{\partial x^{\sigma}}{\partial \bar{x}^{\rho}}\right]\frac{\partial \bar{x}^{\rho}}{\partial x^{\sigma}}\frac{\partial^2 x^{\sigma}}{\partial x^{\beta}\partial \bar{x}^{\rho}} \\
&= \frac{\partial \bar{x}^{\mu}}{\partial x^{\alpha}}J^{\alpha}\det\left[\frac{\partial x^{\sigma}}{\partial \bar{x}^{\rho}}\right] + \frac{\partial \bar{x}^{\mu}}{\partial x^{\alpha}}\mathcal{D}^{\alpha\beta}\det\left[\frac{\partial x^{\sigma}}{\partial \bar{x}^{\rho}}\right]\left(\frac{\partial^2 \bar{x}^{\nu}}{\partial \bar{x}^{\nu}\partial x^{\beta}} + \frac{\partial \bar{x}^{\rho}}{\partial x^{\sigma}}\frac{\partial^2 x^{\sigma}}{\partial x^{\beta}\partial \bar{x}^{\rho}}\right)
\end{aligned}$$

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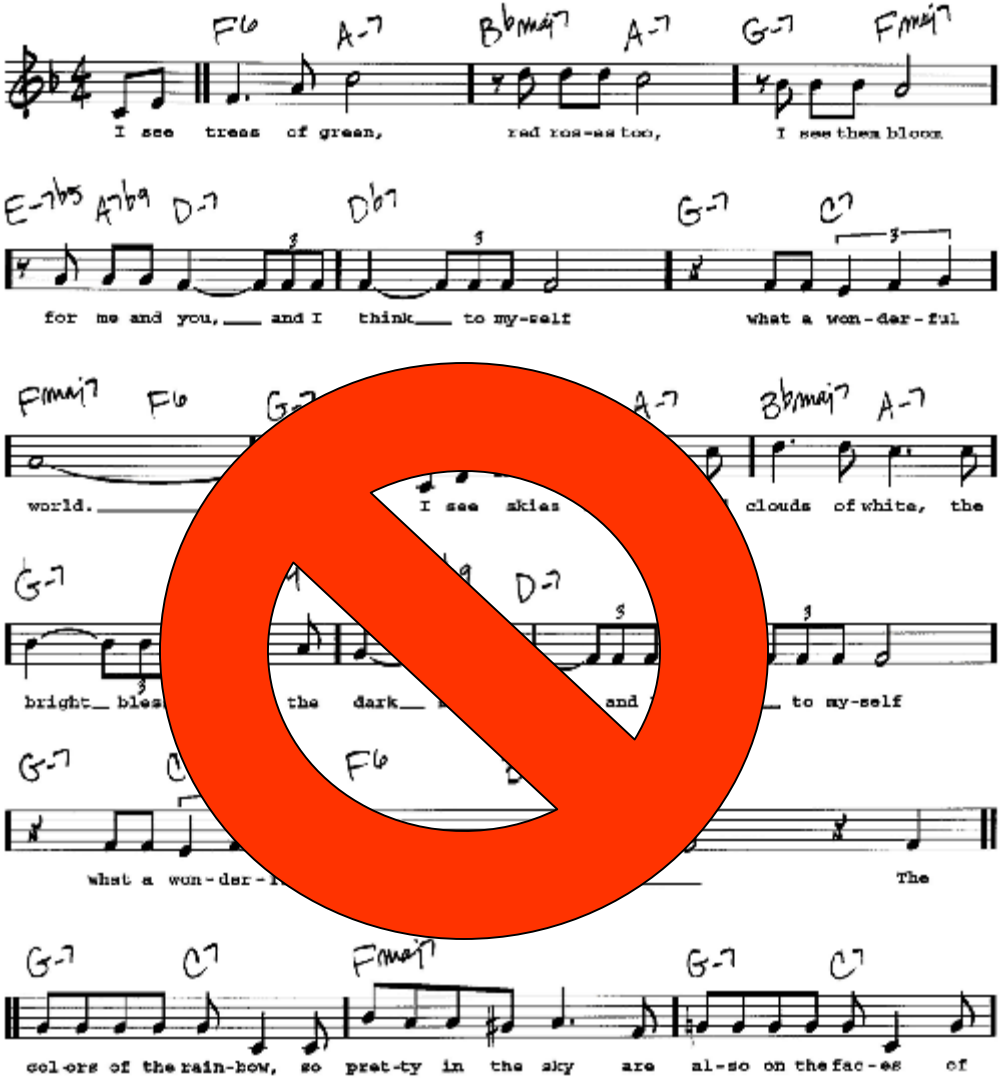
WHAT A WONDERFUL WORLD

- GEORGE DAVID WEISS/ BOB THIELE



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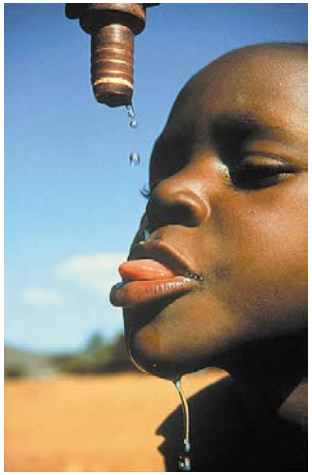
Problematic

- Water
- Energy
- Food



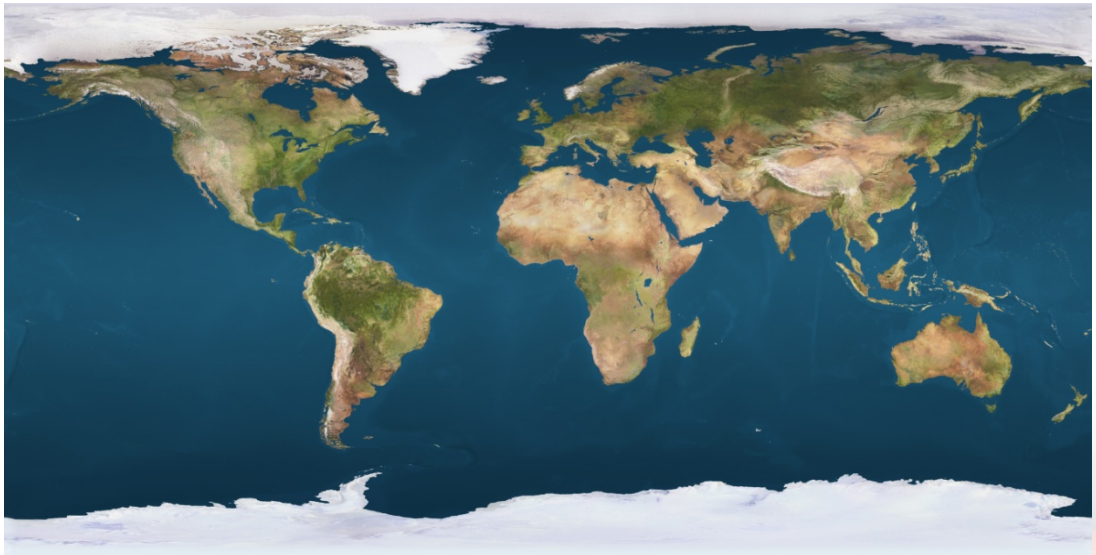
Contemporary context

- Sustainability

- Sustainabilty
- Fairness

Contemporary context

- Sustainability
- Fairness
- Globalization



Knowledge

Science & Technology

"Knowledge of the relevant principles and the ability to obtain appropriate results"

To know, to do.

What, how, when…

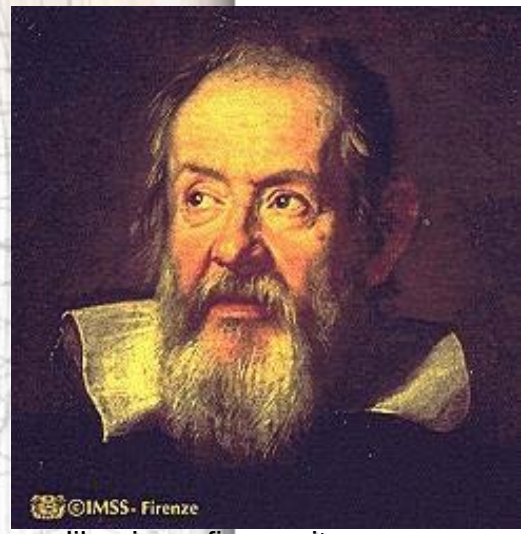
Some questions...

- Why does technology matter?
- Convergence and change?
- Examples of convergence?
- Where is the return on value?
- Does Tech *really* matter?

What do we know about technology?

- We define ourselves by it

Technology as a Transformation Agent



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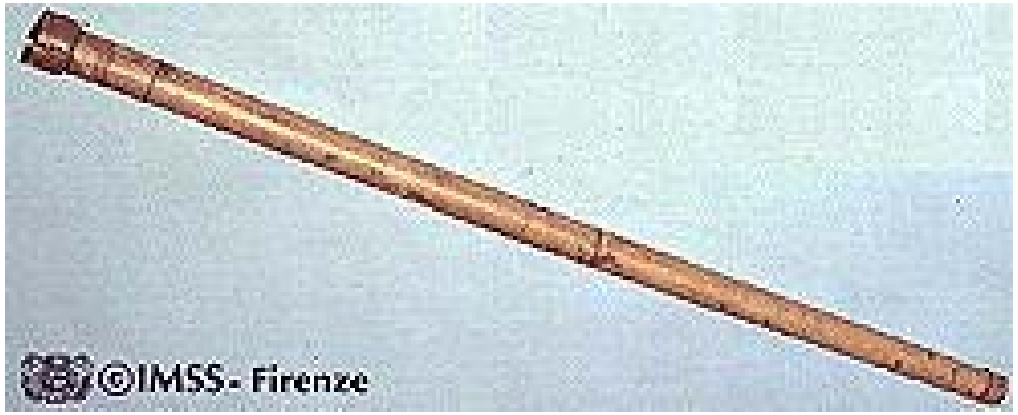

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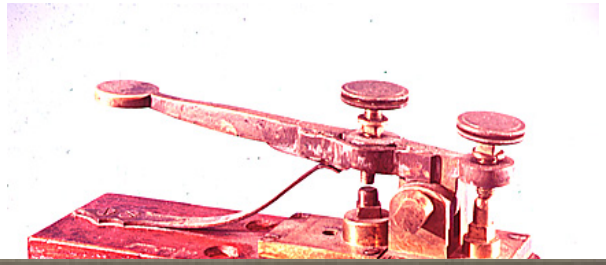
Technological innovation brings about deep change

Significance of the Stirrup in Medieval Warfare
John Hood

The medieval adoption of the stirrup, a piece of equipment unknown to the ancient world, is commonly held to have caused a revolution in the use of the horse for war, a revolution which led to the feudal age and the dominance of the armoured knight mounted on a great warhorse. It is certainly true that the feudal period ought to be

Journal of Ancient and Medieval History

Technology and old paradigms



Men Wanted!!

THE UNDERSIGNED WISHES TO

hire ten or a dozen men, familiar with the management of horses, as hostlers or riders on the Overland Express Route via Salt Lake City. Wages $50 per month and found. I may be found at the St.George Hotel during Sunday, Monday and Tuesday.

William W. Finney

What do we know about technology?

- Its use is paramount

Lessons on Technology

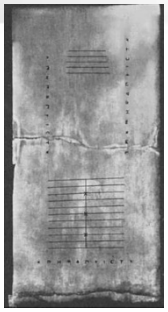
- It is a change agent
- Change is inevitable
- Use is paramount
- Transforms our world vision

What technologies do we need to invest in?

The best return on value from investments in technology are made where technologies converge.

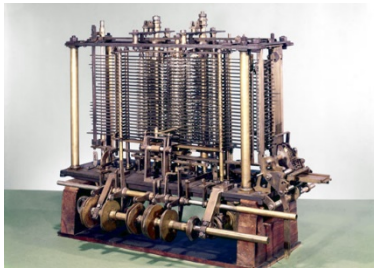
Science and Technology

Computing Machinery Evolution

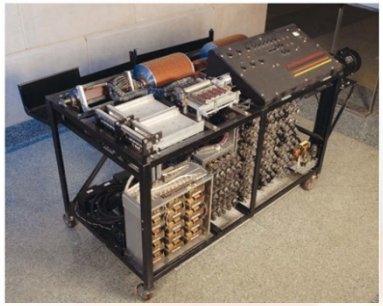


Salamis
Calculating
Board
500 B.C.

Roman
Handheld
Abbacus
300 A.D.

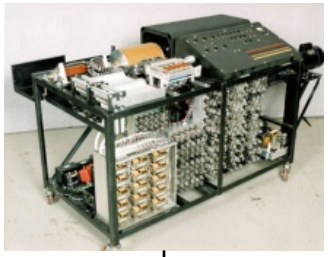


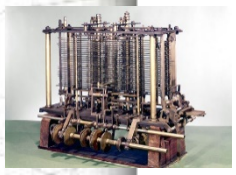
Babbage's
Difference
Engine
1832 A.D.



Atanasoff-Berry
Computer
1939 A.D.

Convergence





- Internet of Things
- Big Data
- The Cloud
- Social Networking
- Mobility
- Public Internet
- Microcomputers
- Minicomputers
- Data Center

1900 1950 2000

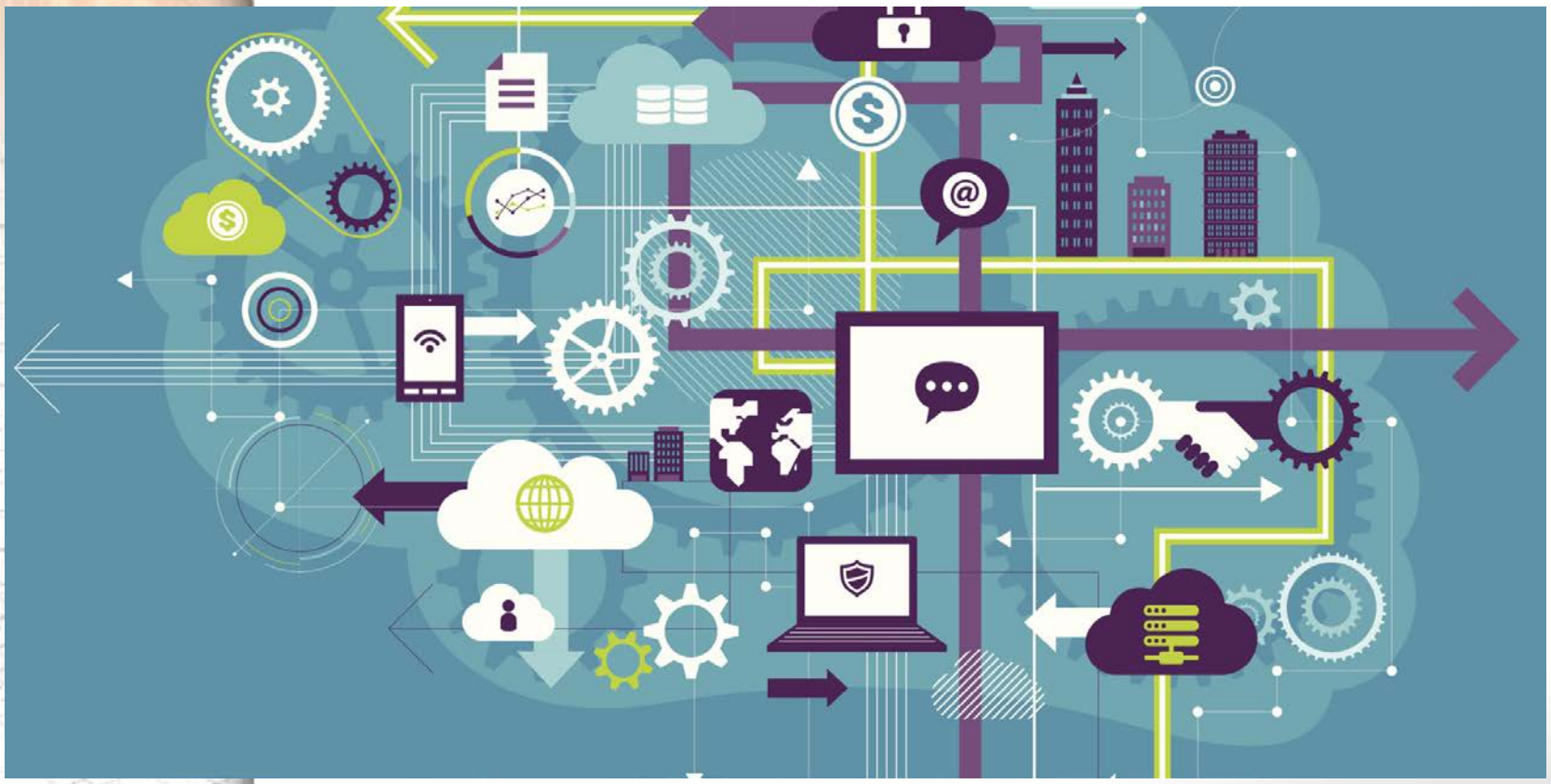
DARPA

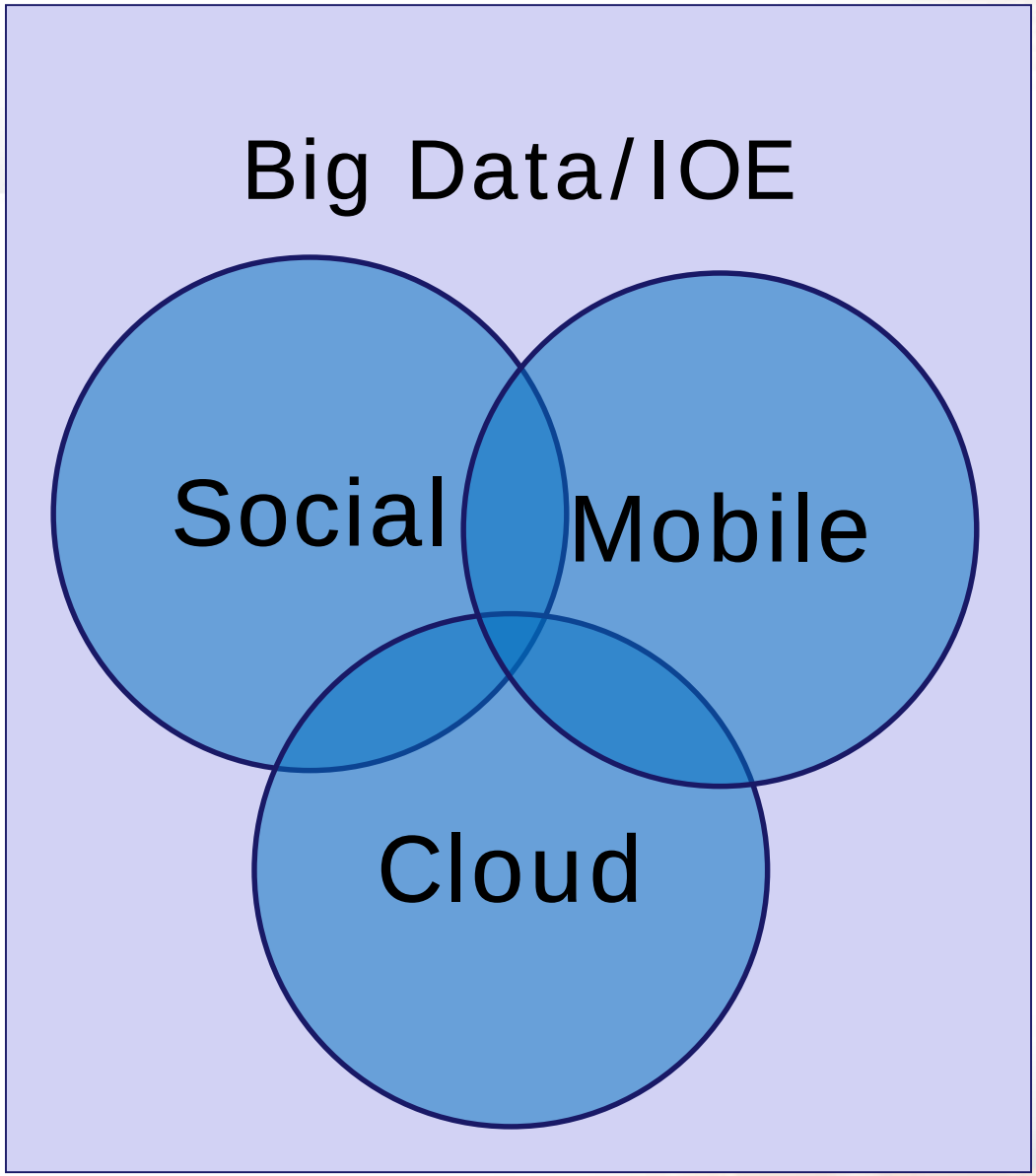
Anytime, anywhere, any device, everything…

What are the current technology triggers?

800,000,000
5,000,000,000
3,500,000,000
28,000,000,000,000,000
350,000,000,000,000,000
Big Data
2,000,000,000
1,500,000,000
87,000,000,000
5,000,000,000

Internet of everything




Big Data/IOE
Social
Mobile
Cloud

The Cloud

- Think of IT as a service
  - Software
  - Data access
  - Storage
- Rapid provisioning
- Nimble scaling
- Focus on core competencies

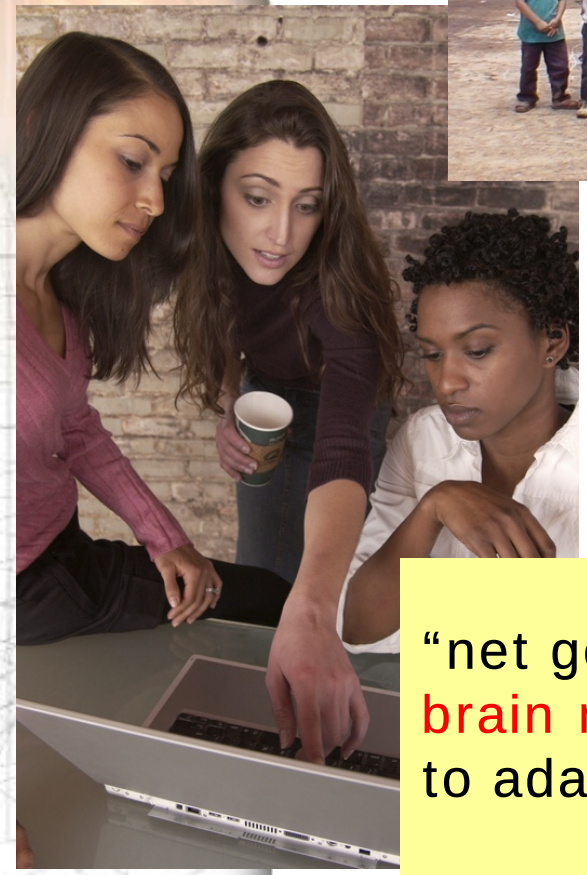
Spending on the cloud is growing five times faster than overall IT spending

Social

- Think about social behavior enhanced by IT
  - Security (connected)
  - Instant gratification (real-time)
  - Belonging (socially produced information)

Young people today

- Collaborative, multi-tasking, non-linear thinkers



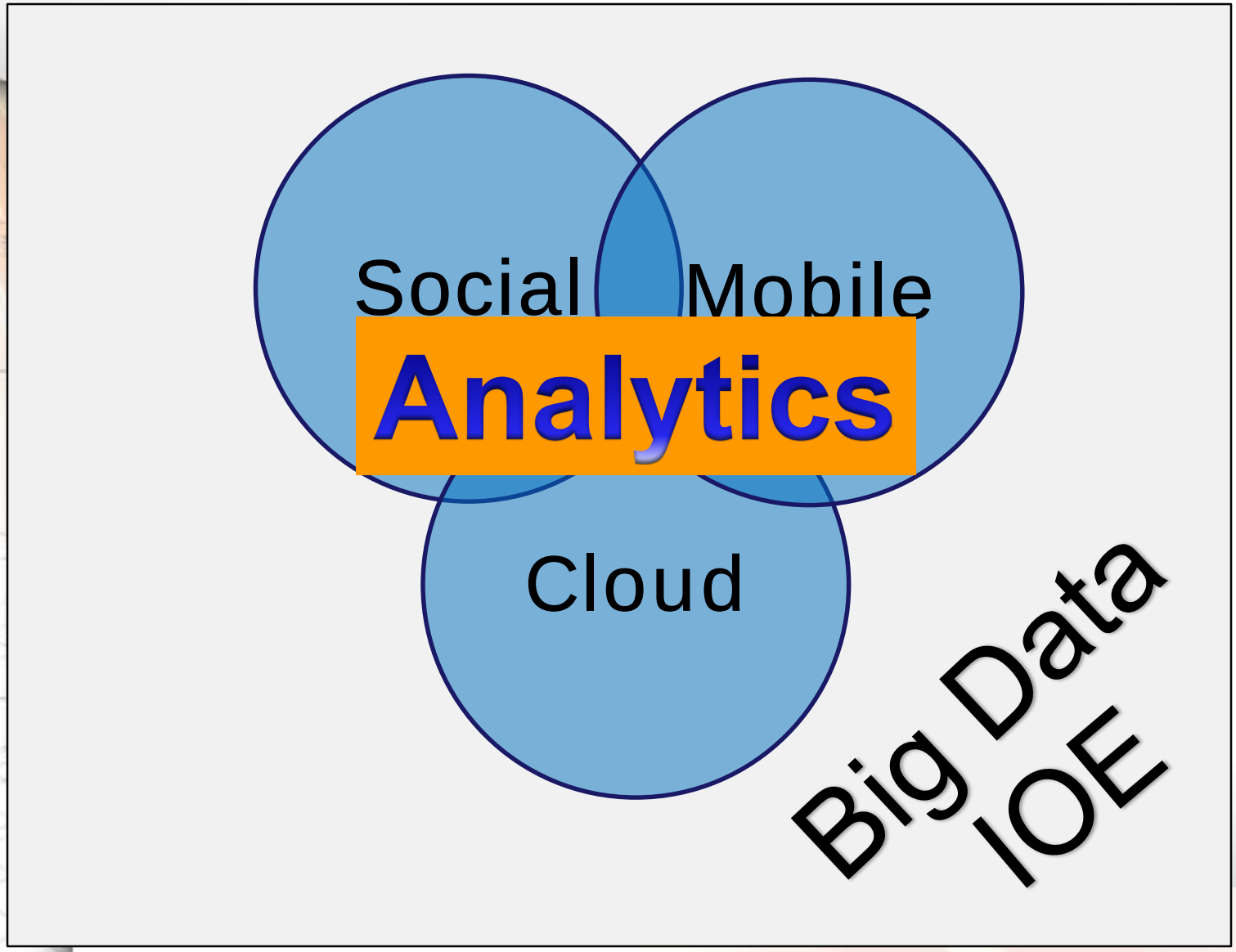
"net generation students has developed brain morphological and fisiological changes to adapt to their surroundings"

Prensky, 2001

Mobile

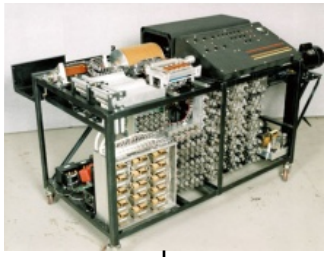
- Think Convenience
  - Highly mobile
  - Context aware
  - Simple

Remember the Sweet Spot



Convergence in Biology

Does it matter?



1905
Agricultural Engineering

1855
Land-Grant
Teaching

1914
Cooperative Extension

1887
Experimental Station
Reseach

1960
Policy Change

Agricultural Eng.
Post harvest, natural resorces, environment…

Ag. & Bio Eng.
Focus on Biosystems

ASABE CIGR

Biological Eng.

1850 1900 1950 2000

Mecanization
Electrification
Transport

UF UNIVERSITY of FLORIDA

Convergence induces change

- Infrastructure
  - 51,000 Cores
  - 3 Petabytes storage
- HPC services
- Faculty awareness Training and Education

More importantly!

What immediate technology convergences are likely to provide value?

Convergence in Education

Campus Technology Magazine — October 2013

Home › Magazine › October 2013 ›

The Online State

Florida is leading the nation with its online education initiatives. Is your state next?

Who Owns College Courses?

Flexible and open models are changing the way universities approach content ownership.

How to Teach Entrepreneurship

Entrepreneurship programs can help prepare students for a changing economy and workplace.

Recommend
Sign Up to see what your friends recommend.
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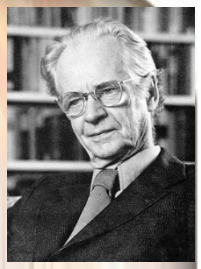
CAMPUS TECHNOLOGY
Support Next-Gen Learning Environments
and unlock the promise of anytime,

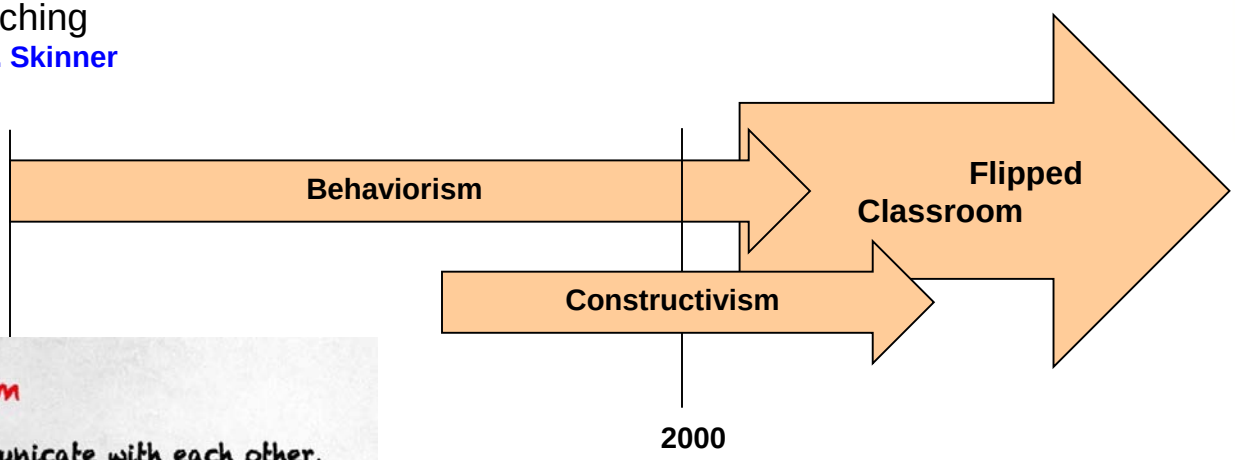
Improved learning outcomes
Reduced cost of instruction

Convergence in education



Teachers must learn how to teach… they need only to be taught more effective ways of teaching

B.F. Skinner



Constructivism

Learners communicate with each other, and share their understandings, feelings, knowledge, and experience, to come up with new knowledge.

The teacher becomes the facilitator, and the learners are encouraged to interact, exchange views and experience and co-construct meaning and knowledge that is based on their needs (still with the teachers' intervention.)

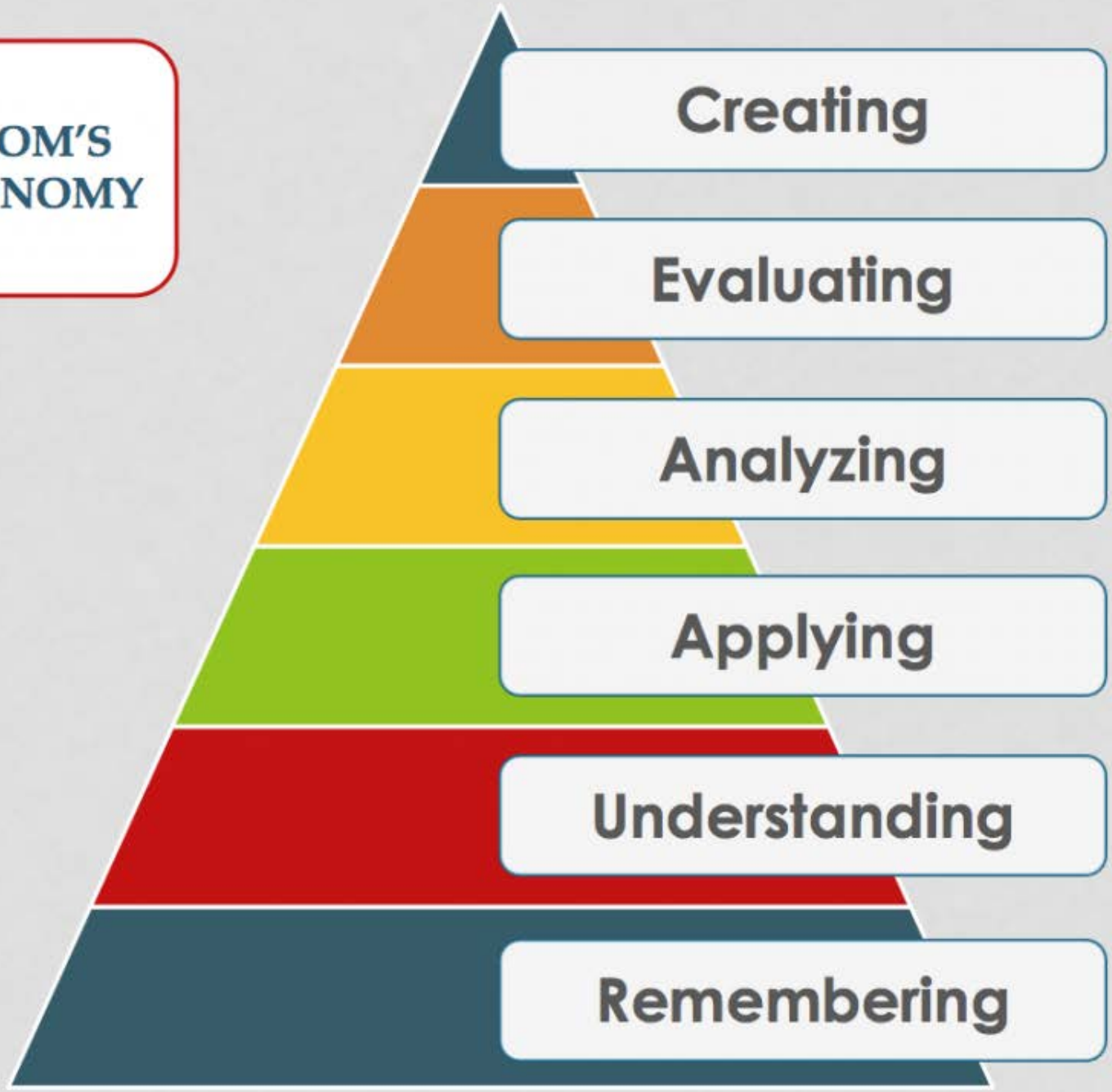
Reflective abstraction, however, is based not on individual actions but on coordinated actions.

Jean Piaget

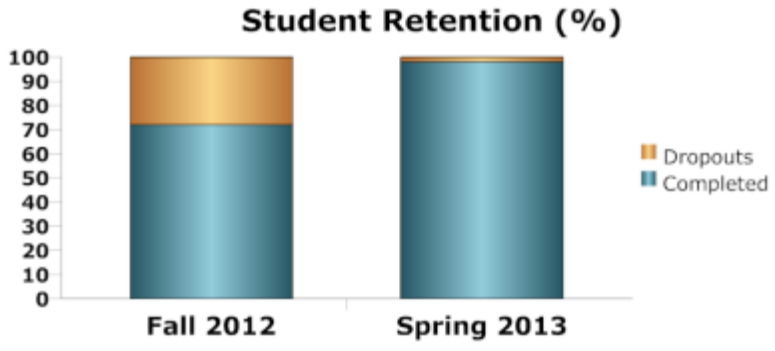
Flipped Classroom

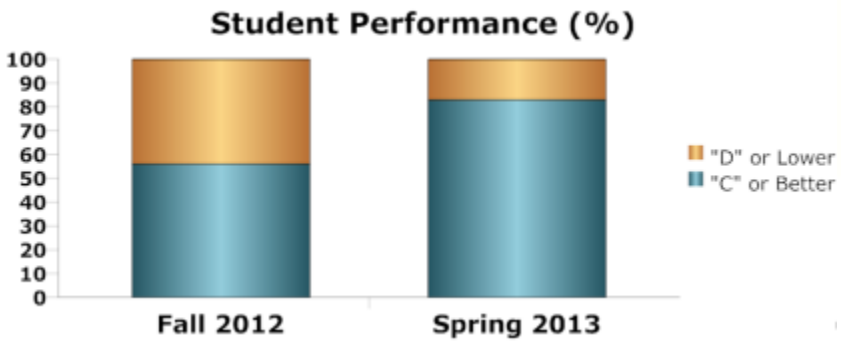
Traditional Classroom	Lecture is delivered by the instructor	Homework is assigned to reinforce understanding
Flipped Classroom	Students watch lectures Online	Classroom time devoted to higher order thinking tasks

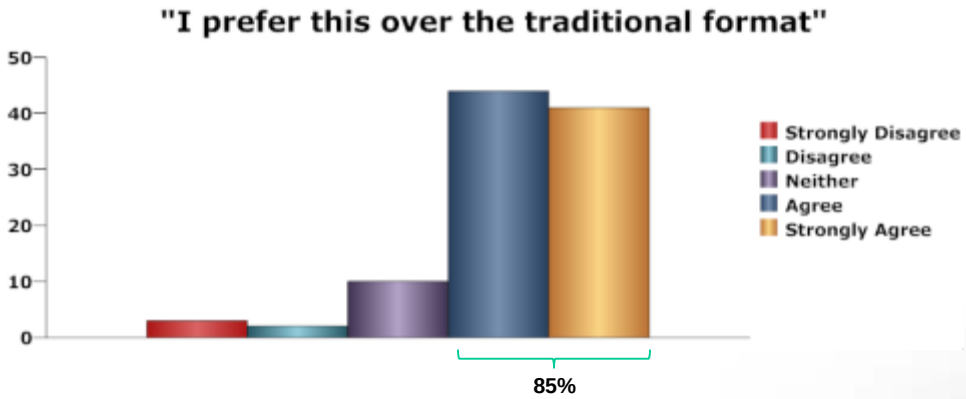
BLOOM'S TAXONOMY

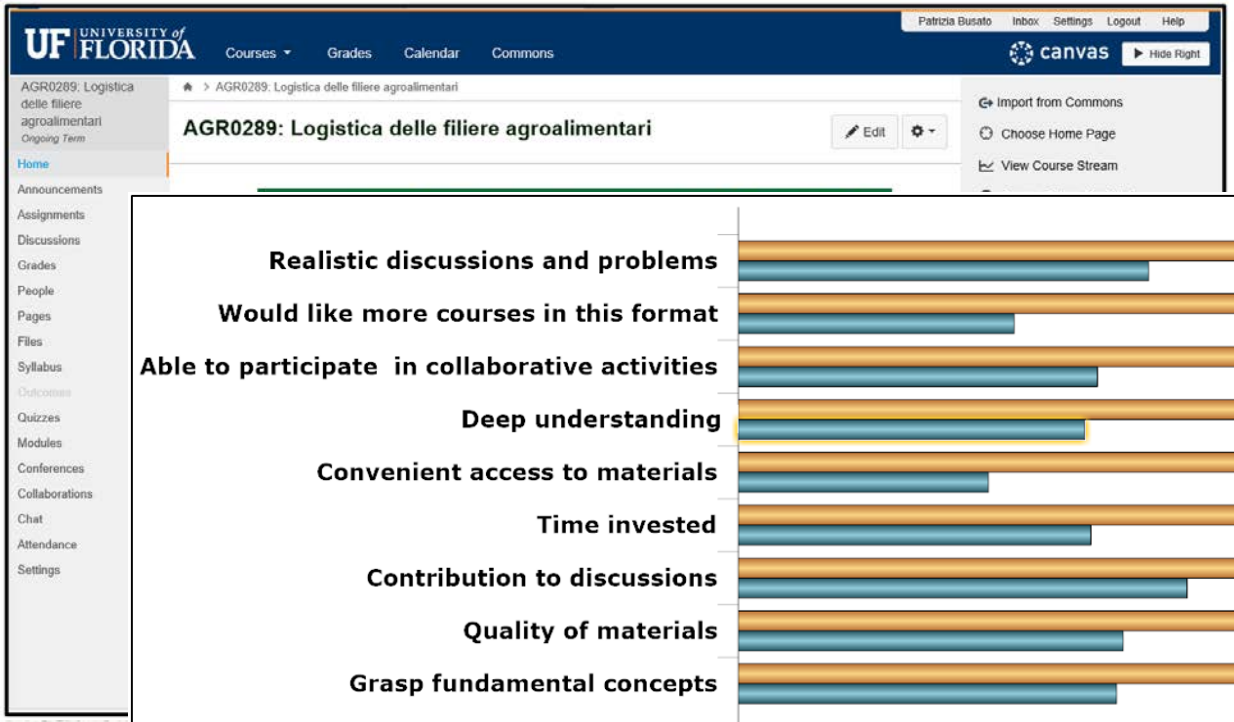


EEL3111C Circuits 1









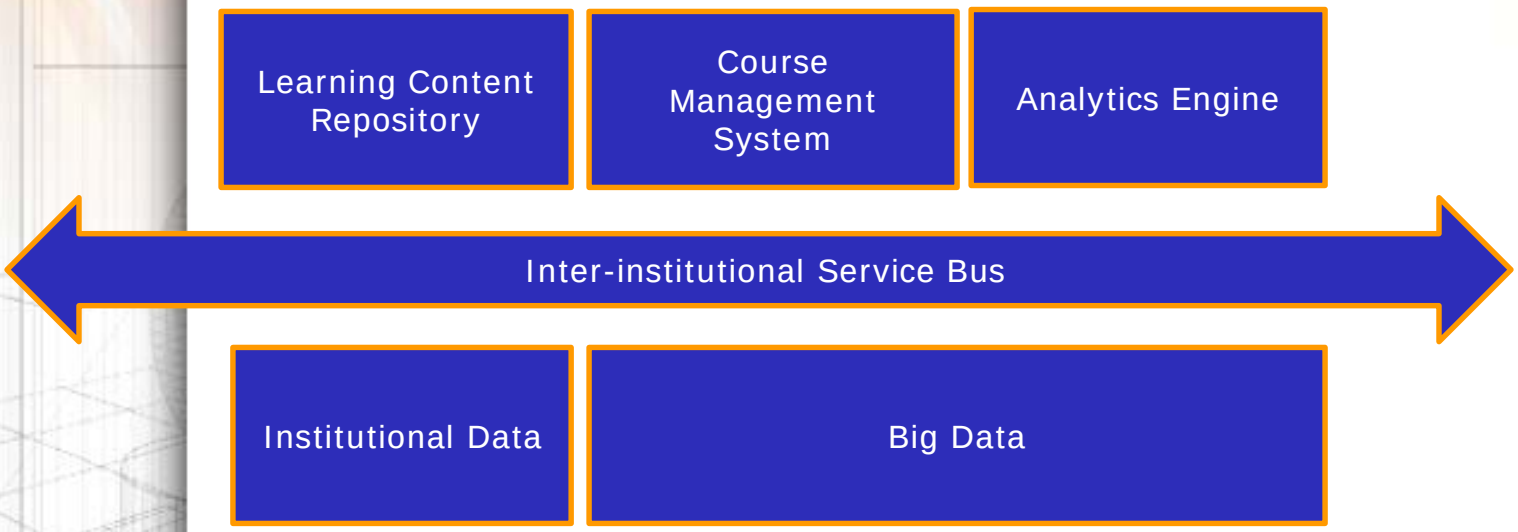
Summary Statistics for Student Evaluation*
(Highlighted scores are associated to the Flipped Classroom)

	Module 1		Module 2	
	Mean	Standard deviation	Mean	Standard Deviation
Group A	100	0	78.47	23.6
Group B	62.38	18.66	97.62	2.06

** One student from each group not completing the modules was removed from the analysis.*

Credits: P.Busato and R. Berruto

Strategic action
Create a learning ecosystem

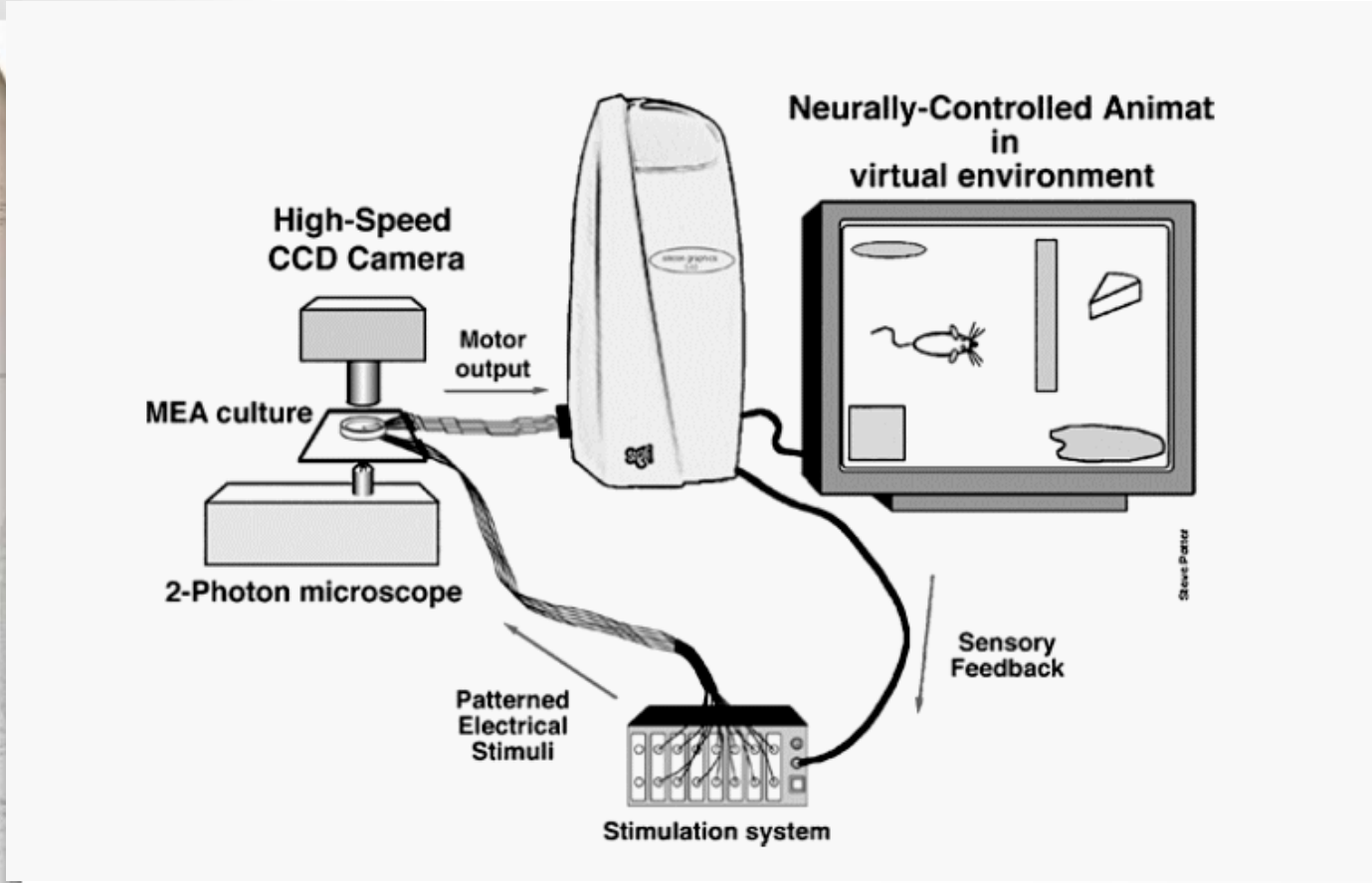


Science ant technology for the XXIst century

- ITC
- Biology

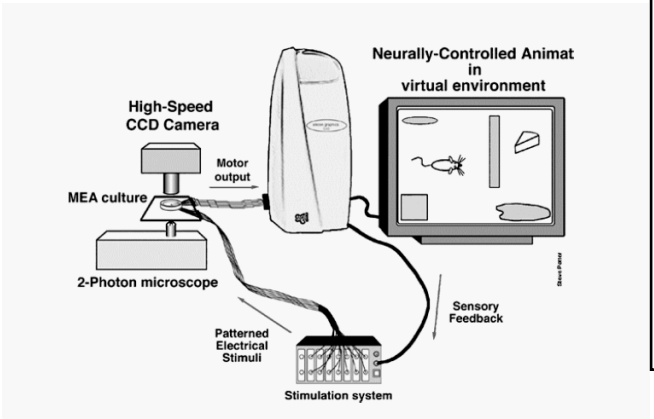
- Brain
- Nanotecnology
- Mecatronics
- Materials
- Energy

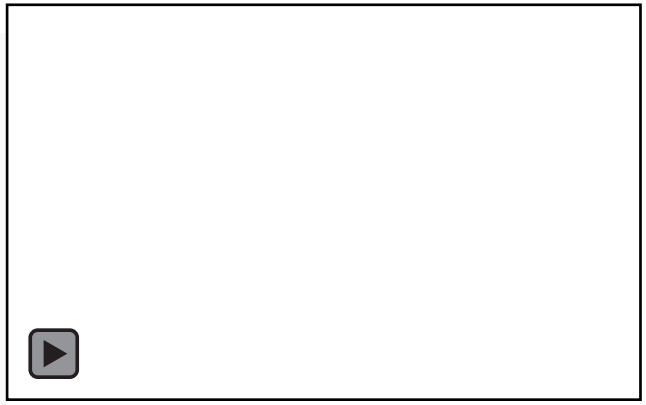
Convergence: Neurons and bits

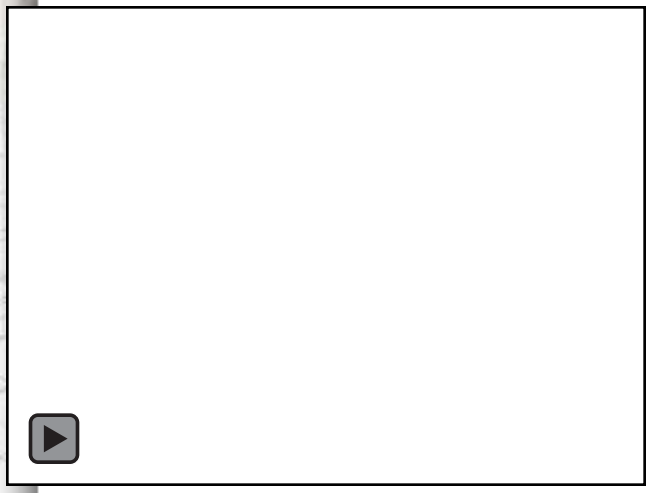


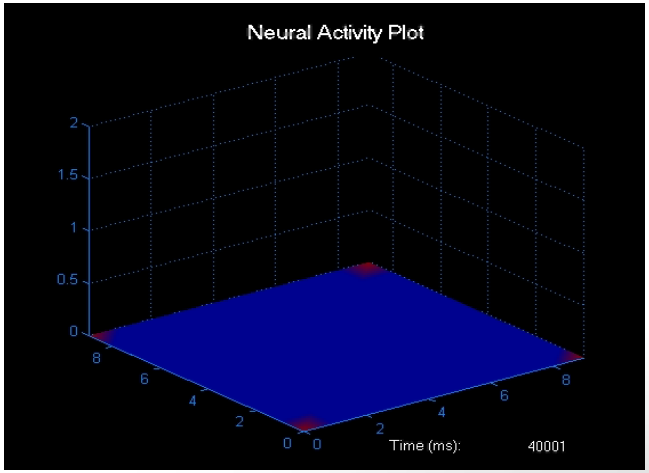
Credits: T.B. deMarse

Autómatas









Credits: T.B. deMarse

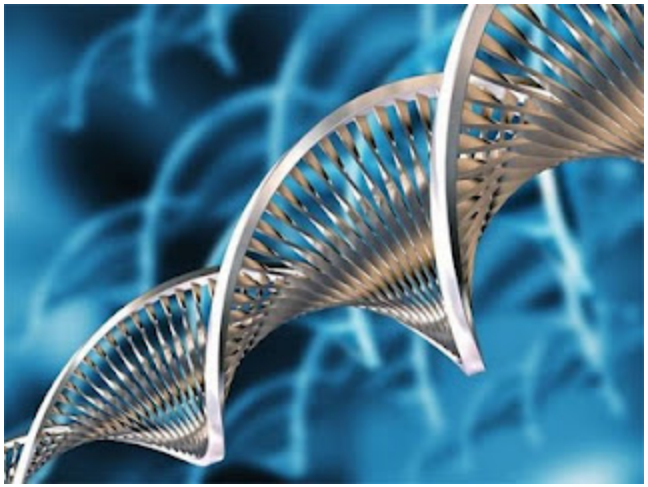
Value?

Information technology

- The art of acquiring, storing, transmitting and analyzing for decision making and creating new knowledge

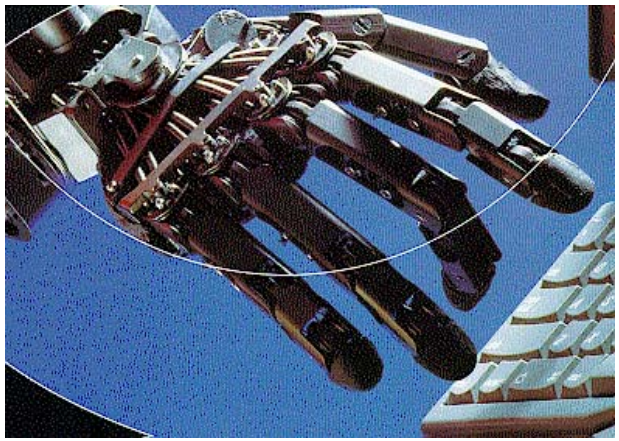
Biotecnology

- The art of using biological systems to create products and processes



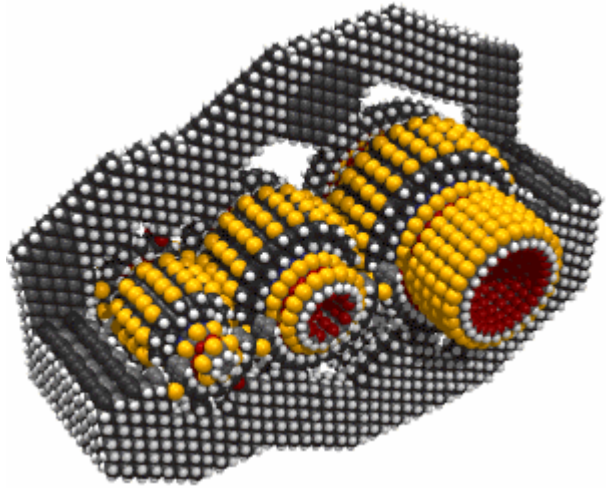
Mecatronics

- The art of construction of intelligent mechanical systems



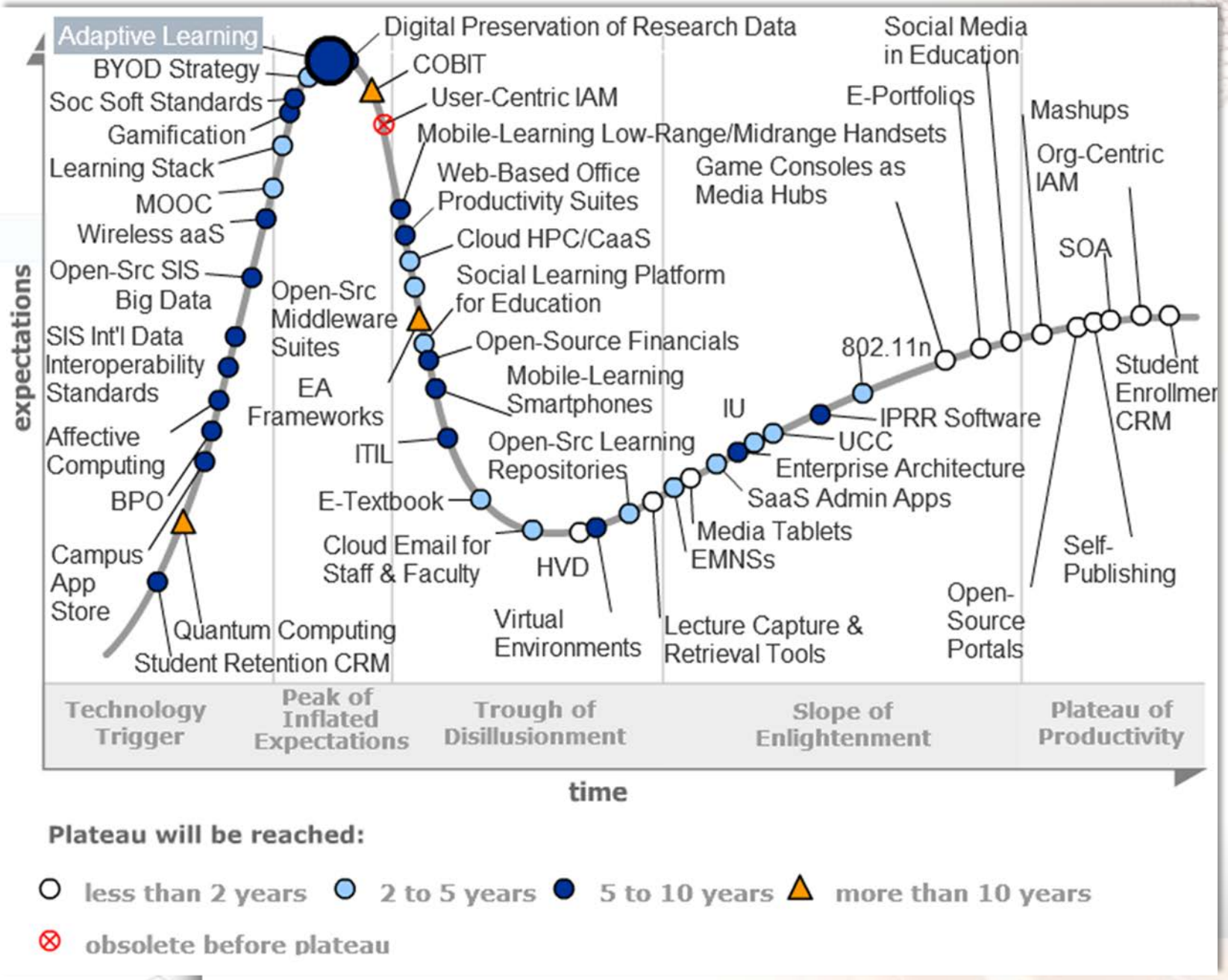
Nanotecnology

- The art of molecular level construction



Brain technologies

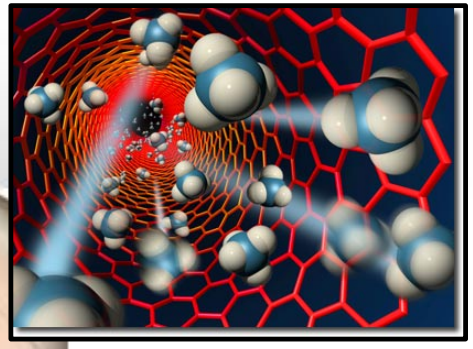
Where are the opportunities?

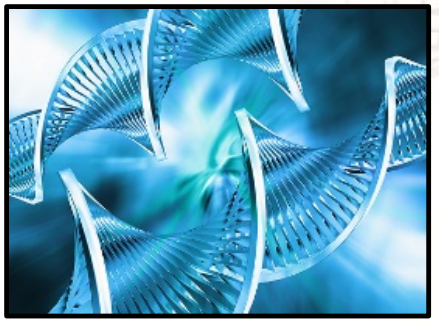

Adaptive Learning
BYOD Strategy
Soc Soft Standards
Gamification
Learning Stack
MOOC
Wireless aaS
Open-Src SIS
Big Data
SIS Int'l Data
Interoperability
Standards
Affective
Computing
BPO
Campus
App
Store
Quantum Computing
Student Retention CRM
Open-Src
Middleware
Suites
EA
Frameworks
ITIL
E-Textbook
Cloud Email for
Staff & Faculty
Digital Preservation of Research Data
COBIT
User-Centric IAM
Mobile-Learning Low-Range/Midrange Handsets
Web-Based Office
Productivity Suites
Cloud HPC/CaaS
Social Learning Platform
for Education
Open-Source Financials
Mobile-Learning
Smartphones
Open-Src Learning
Repositories
HVD
Virtual
Environments
Social Media
in Education
E-Portfolios
Mashups
Org-Centric
IAM
Game Consoles as
Media Hubs
SOA
802.11n
Student
Enrollmer
CRM
IU
IPRR Software
UCC
Enterprise Architecture
SaaS Admin Apps
Media Tablets
EMNSs
Lecture Capture &
Retrieval Tools
Self-
Publishing
Open-
Source
Portals
expectations
Technology
Trigger
Peak of
Inflated
Expectations
Trough of
Disillusionment
Slope of
Enlightenment
Plateau of
Productivity
time
Plateau will be reached:
less than 2 years
2 to 5 years
5 to 10 years
more than 10 years
obsolete before plateau

Anticipating the future…

All is connected
and aware

Good strategy and
intelligent tactics





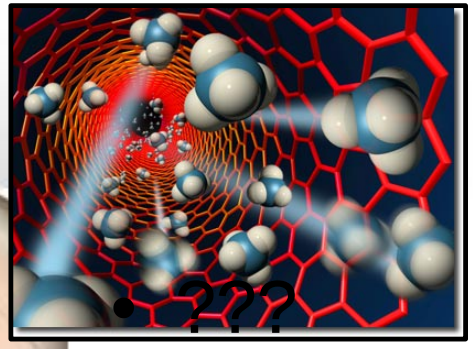
atoms

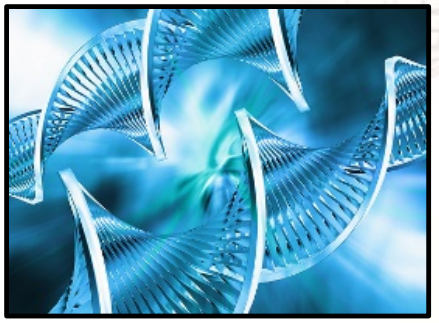
bits

Innovation

genes

neurons





atoms

bits

??? tech

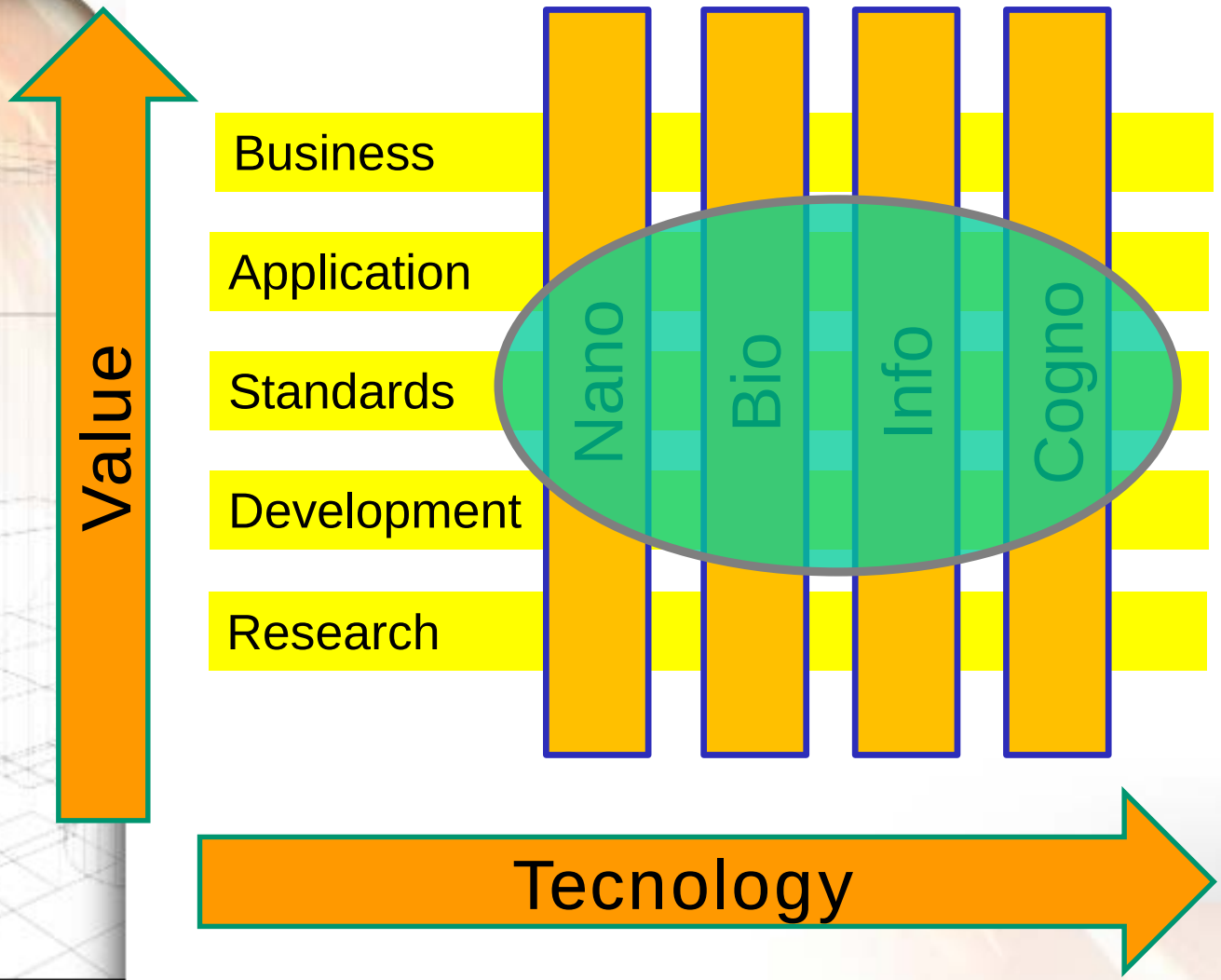
genes

neurons

Science and technolgy are only part of a complex ecosystem

- Economics
- Risk
  - Health
  - Environment
- Acceptance
- Regulation
- Intellectual Property
- Local and global politics
- Etc.

Social, legal and ethical



Translating these findings

Adoption Paradigms

Participatory	Advisory Work	Facilitation for Empowerment
Paternalistic	Technology Transfer	Human Resource Development
	Persuasive	Educational

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What is it about science technology that is so important today?

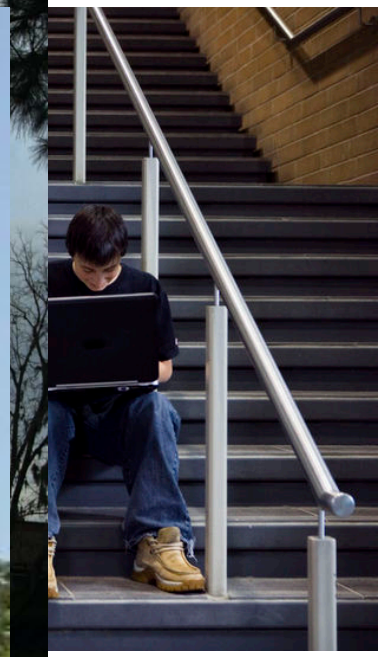
From Literacy to Electracy

Oral Tradit

Literate Tradition

Extended Virtual Tradition

Thank you!



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