POLITECNICO DI MILANO

Knowledge Aided Engineering Manufacturing and Related Technologies

Metodologie, Tecnologie, Architetture, Prodotti per competere nella IV rivoluzione industriale

Udine, 5 maggio 2016

In un mondo di slogan e sigle, quali sono i problemi prioritari da risolvere? Con quale metodologia e con quali strumenti?

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Outline

- Slogan e sigle
- Il quadro / lo scenario di riferimento
- Quali i veri problemi
- Come affrontarli

Slogan, Hot words or buzzwords ?

3D Printing
4th Industrial Revolution
Additive Manufacturing
AGILE
AR and VR
CAD
CIM
Circular Economy
Cloud
Common Research
Complexity
Connectivity
Continuous
Change
Cooperation
Cyber-Physical Systems
Digital Enterprise
Digital Manufacturing
Eco Design
Exponential Evolution
Federation
Functional Modeling
Globalization
Horizon 2020
Human resources
Hybrid Manufacturing
Incubators
Industry 4.0
Innovation Rate
Internal Knowledge exploitation
IoE
IoT
M&A
Mobility
Multi-
Open Innovation
Optimization
PDM
Platform-based SW
PLM
Regional programs
Shared Knowledge
Simulation Based Design
Singularity
Smart Factory
Smart Manufacturing
Start Up
System > Product > Service
TRIZ
User Centered Design
UX Design
Virtual Prototyping
Virtualization
……..

Un analisi semantica

CONTEXT	Actual Problem	Opportunities	Enabling Technologies
4th Industrial Revolution	Clear Vision	Common Research	3D Printing
Additive Manufacturing	Control	Cooperation	AGILE
Circular Economy	Customization	Federation	AR and VR
Cloud	Efficiency	Horizon 2020	CAD
Complexity	Fast response	Human resources	CIM
Connectivity	Flexibility	Incubators	Cloud
Continuous Change	Innovation	Internal Knowledge explo	Eco Design
Cyber-Physical Systems	Mobility	M&A	Functional Modeling
Digital Enterprise	Perceived Value	Regional programs	Hybrid Manufacturing
Digital Manufacturing	Plan	Shared Knowledge	IoT
Exponential Evolution	Product Development	Start Up	Mobility
Globalization	Process Optimization		Open Innovation
Industry 4.0	Reliability Strategy		Optimization
Innovation Rate	Tacit Knowledge		PDM
IoE			Platform-based SW
IoT			PLM
Mobility			Simulation Based Design
Multi-			TRIZ
Singularity			User Centered Design
Smart Factory			UX Design
Smart Manufacturing			Virtual Prototyping
System > Product > Service			
Virtualization			

Quindi ….

Necessità di chiarire…

…. per definire un quadro di riferimento in cui collocare:

- Il contesto
- I trends
  - Nel contesto globale
  - Nei contesti specifici
- I problemi
  - Reali e/o potenziali
  - Attuali e/o futuri
  - Le loro cause, conseguenze e possibilità di soluzione
- Le disruptions
- Le opportunità
  - Attuali e/o future
  - Reali e/o potenziali
  - Per chi
- Gli attori
  - Con i loro ruoli
  - Con i loro interessi (espliciti ed impliciti)
  - Con i loro legami e conflitti

Come creare slogan e sigle

CONTEXT

Local
Sectorial
National
Global

Adjective

Circular
Smart
Digital
Virtual
Exponential
Continuous
Mobile
4.0
Global
Open

Subject

- Economy
- Industry
- Enterprise
- Factory

Process

- Innovation
- Product Development
- Manufacturing
- Supply Chain

How?

- Change
- Share
- Federate
- Co-Work

New Enabling Technologies

- IoT
- IoE
- Cloud
- Virtualization
- Mobility
- Complexity
- Multi-
- Open
- Agile
- VP
- Platform-based
- Cyber-Physical Systems

Dove e chi ne parla …

DOVE

Giornali

Convegni su :

- Politiche economiche
- Innovazione
- Finanziamenti EU, nazionali e regionail
- Strategie

Eventi marketing di vendors e consulenti

Fiere di settore

Webinar

……..

Cazzeggio alla moda

CHI

Giornalisti

Economisti

Politici

Vendors

Consulenti vari

Accademici

Pianificatori

Associazionisti

……..

…. **e gli Industriali ?**

…. **specie delle PMI ?**

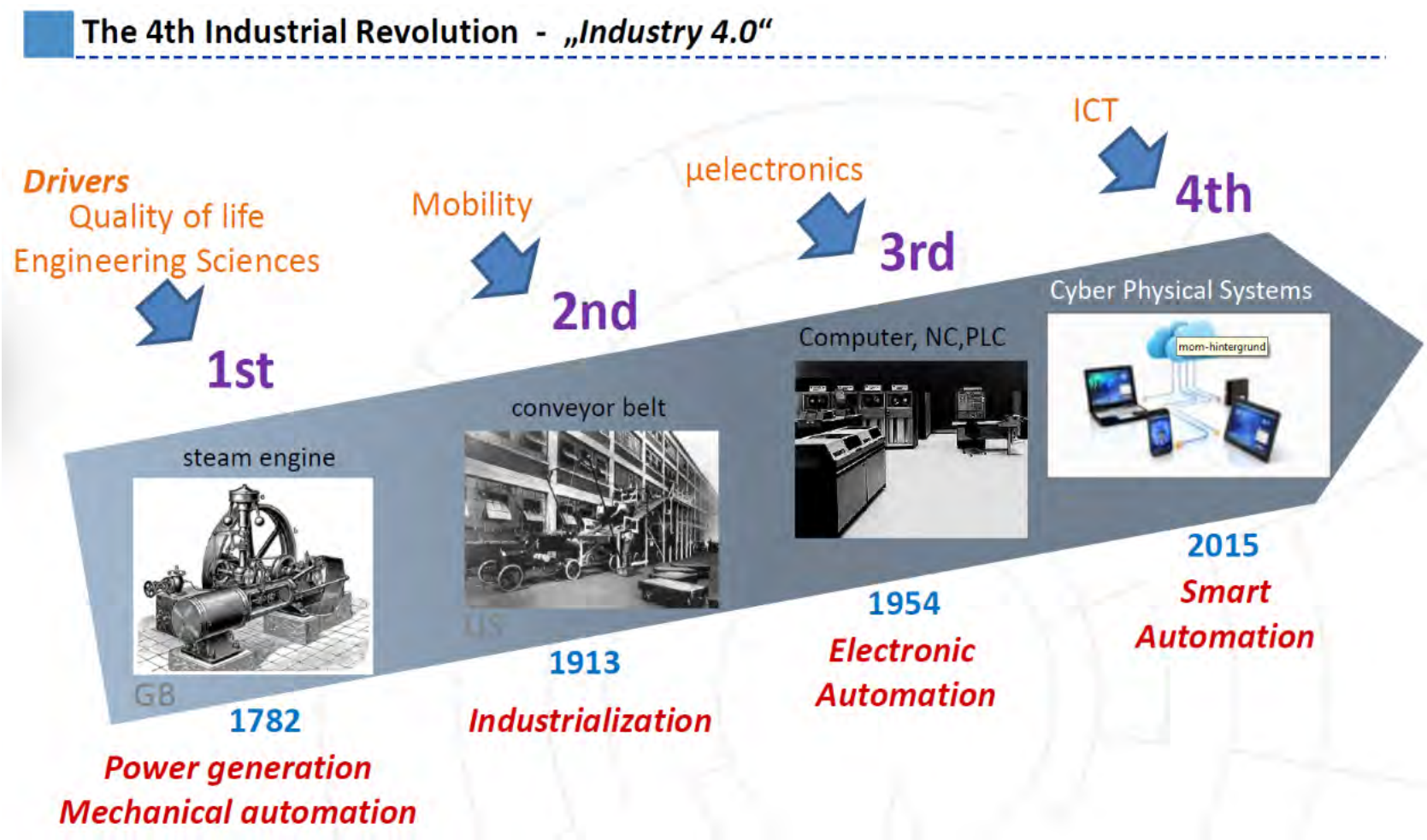
4th Industrial Revolution

Navigating the next industrial revolution

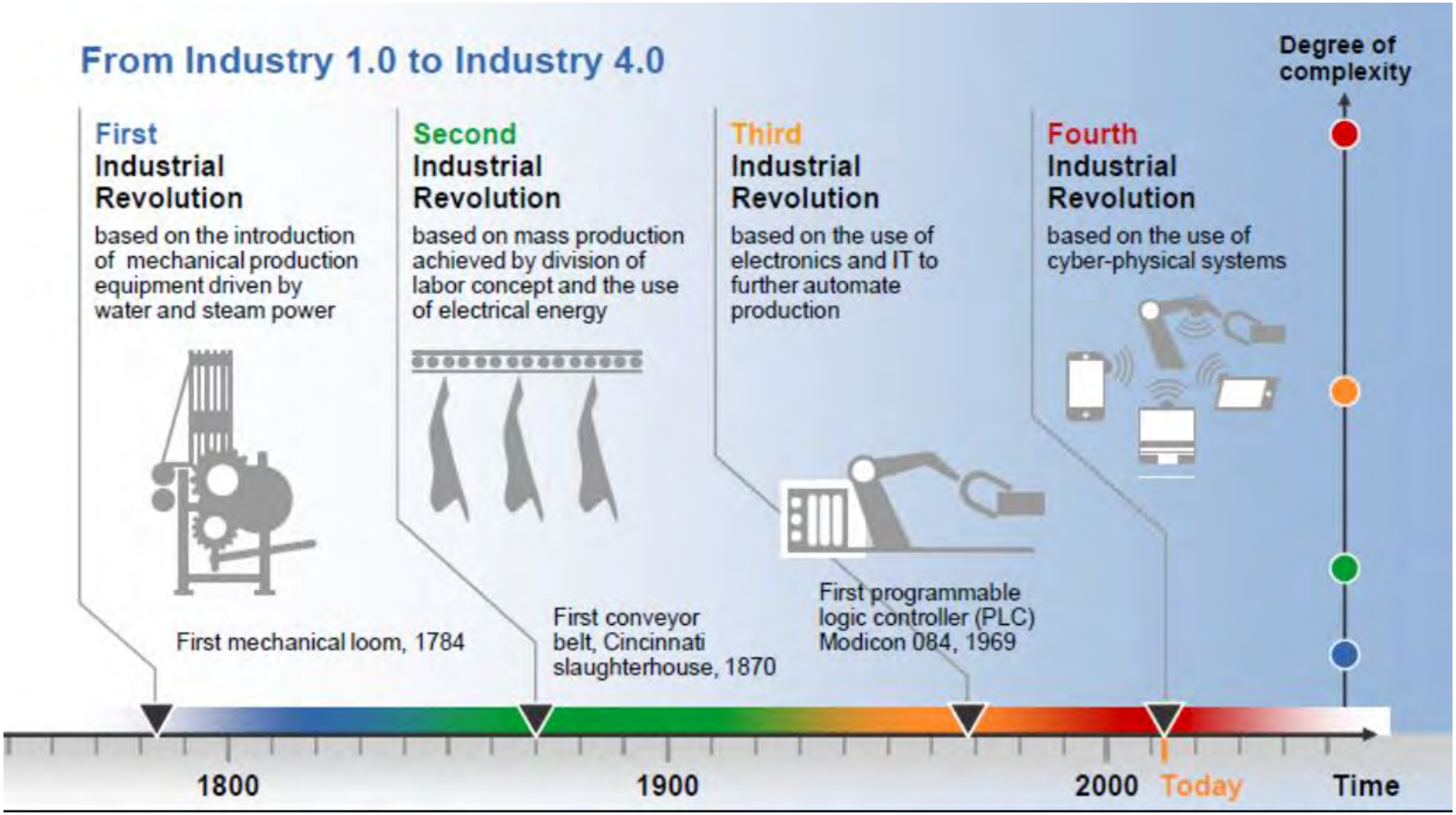
WORLD ECONOMIC FORUM

Revolution	Year	Information
1	1784	Steam, water, mechanical production equipment
2	1870	Division of labour, electricity, mass production
3	1969	Electronics, IT, automated production
4	?	Cyber-physical systems

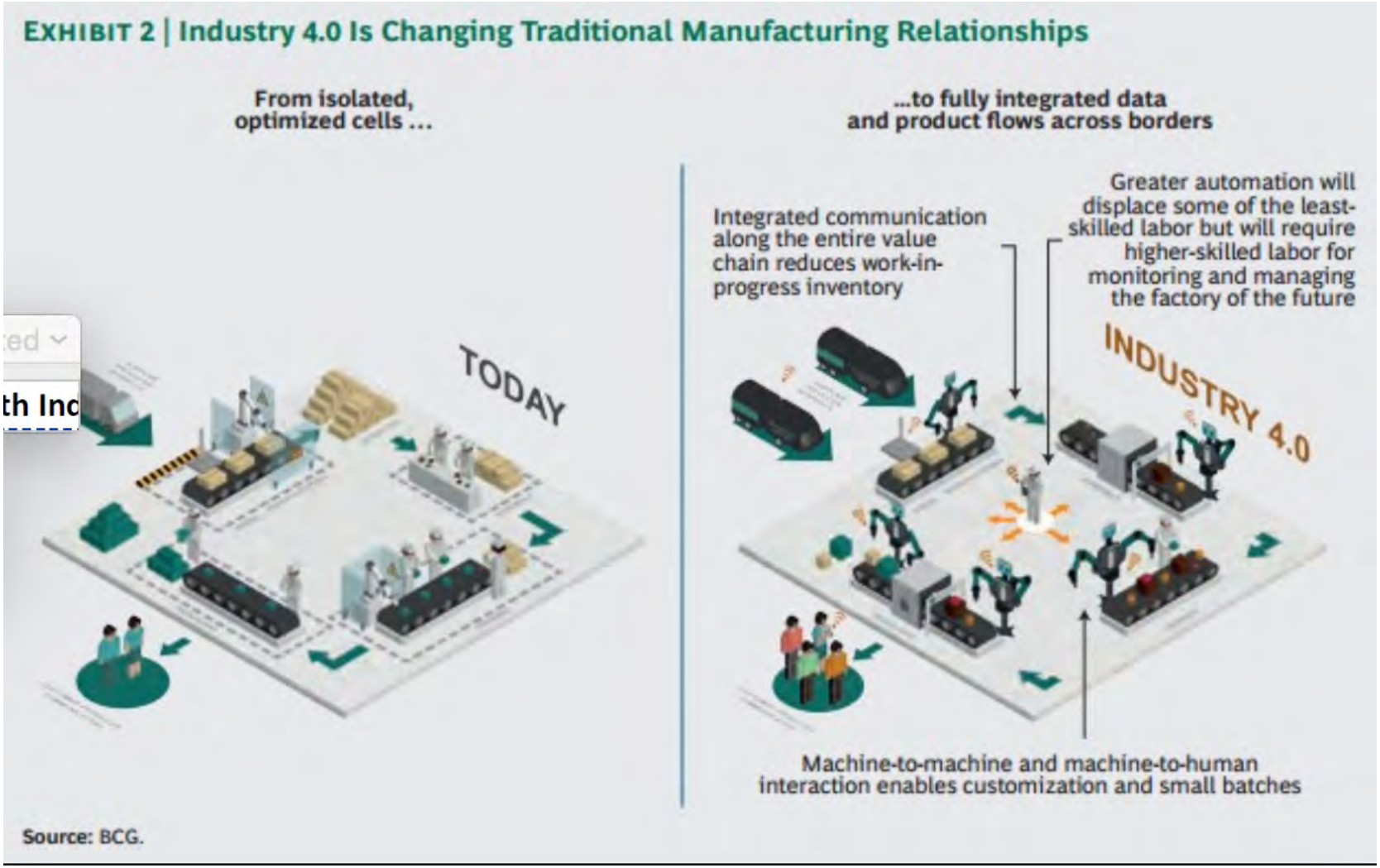
4th Industrial Revolution and Industry 4.0



4th Industrial Revolution and Industry 4.0

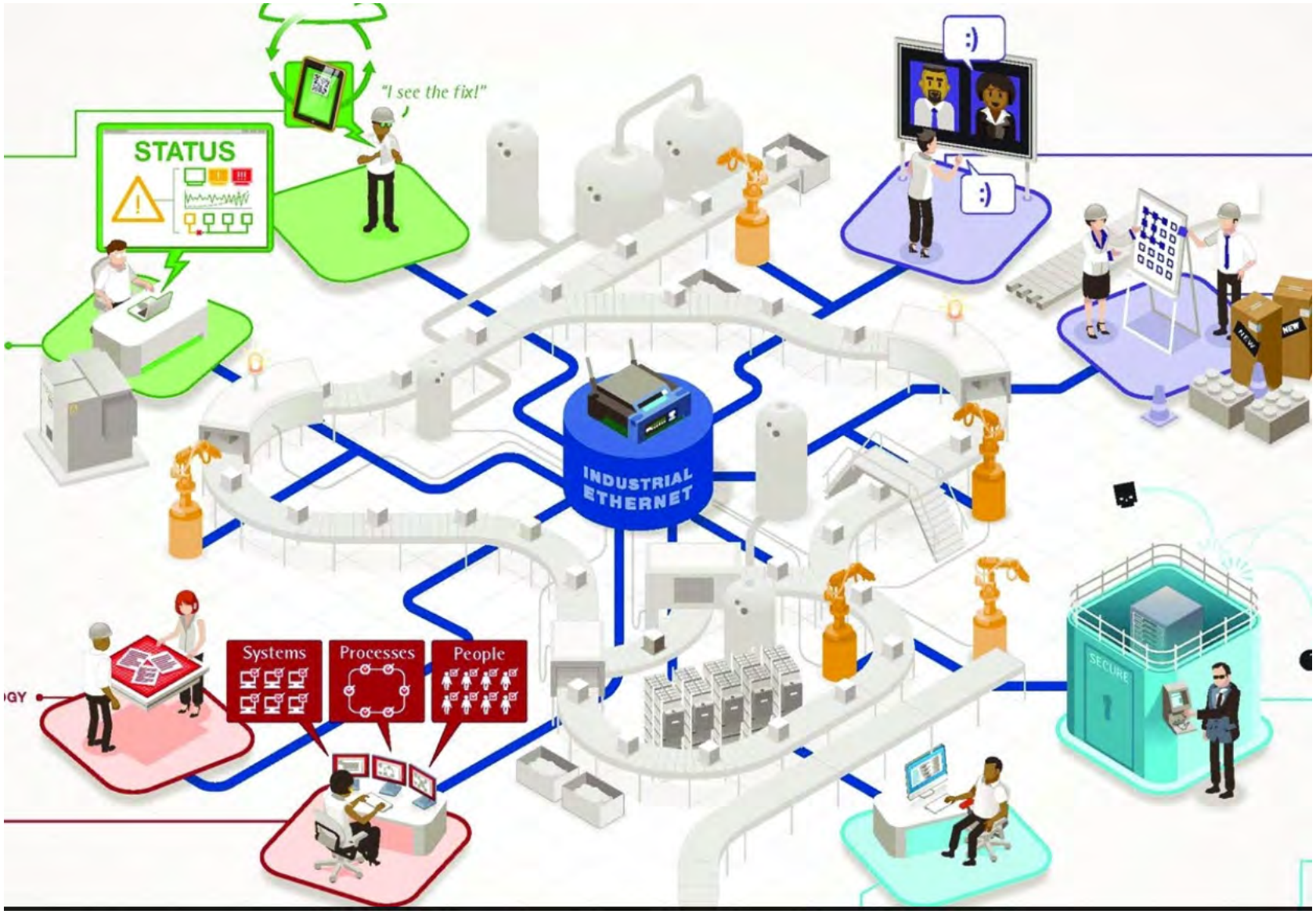


4th Industrial Revolution and Industry 4.0

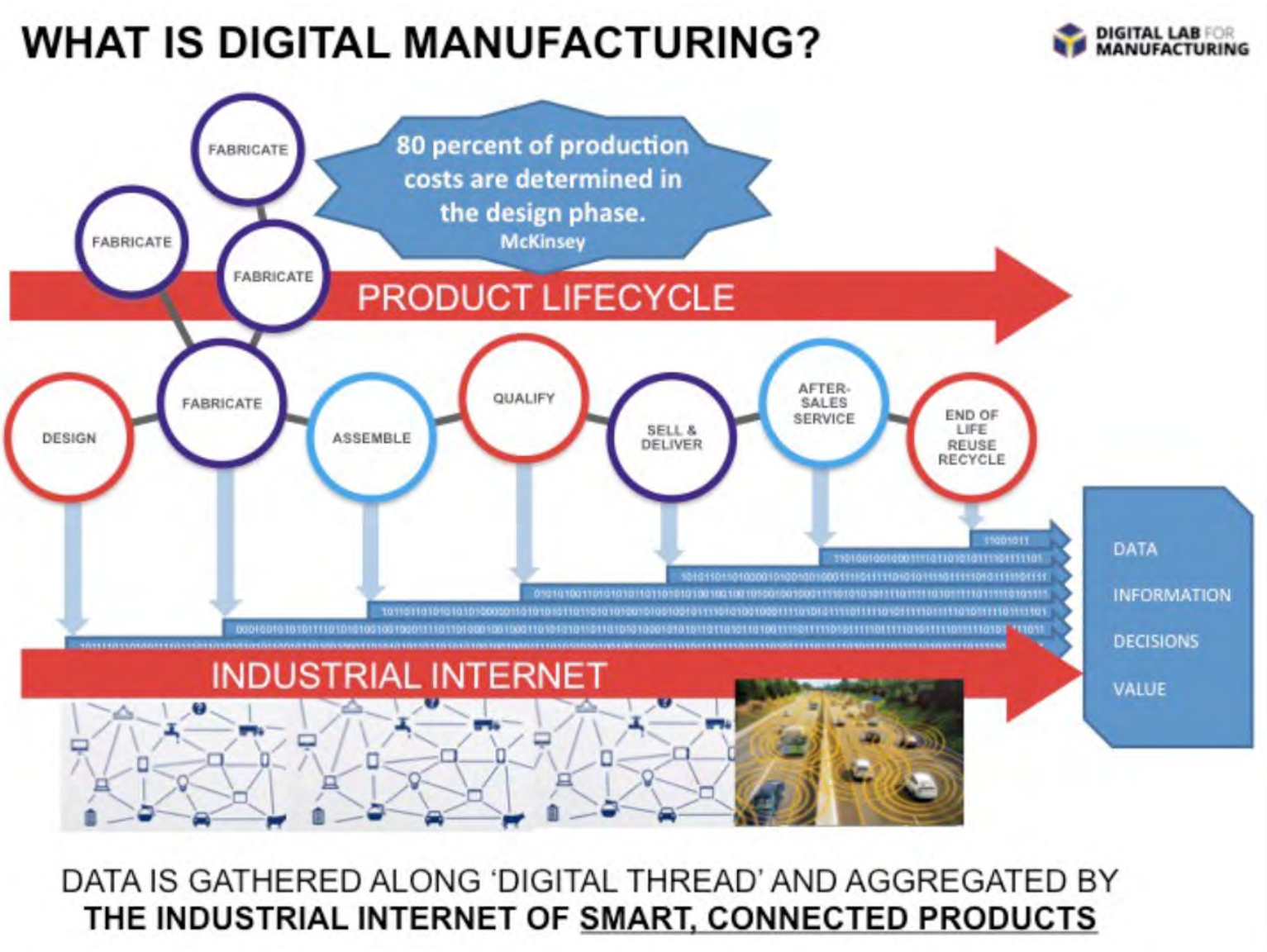


4th Industrial Revolution and Industry 4.0

Smart manufacturing



Digital Manufacturing



Il quadro di riferimento / lo scenario

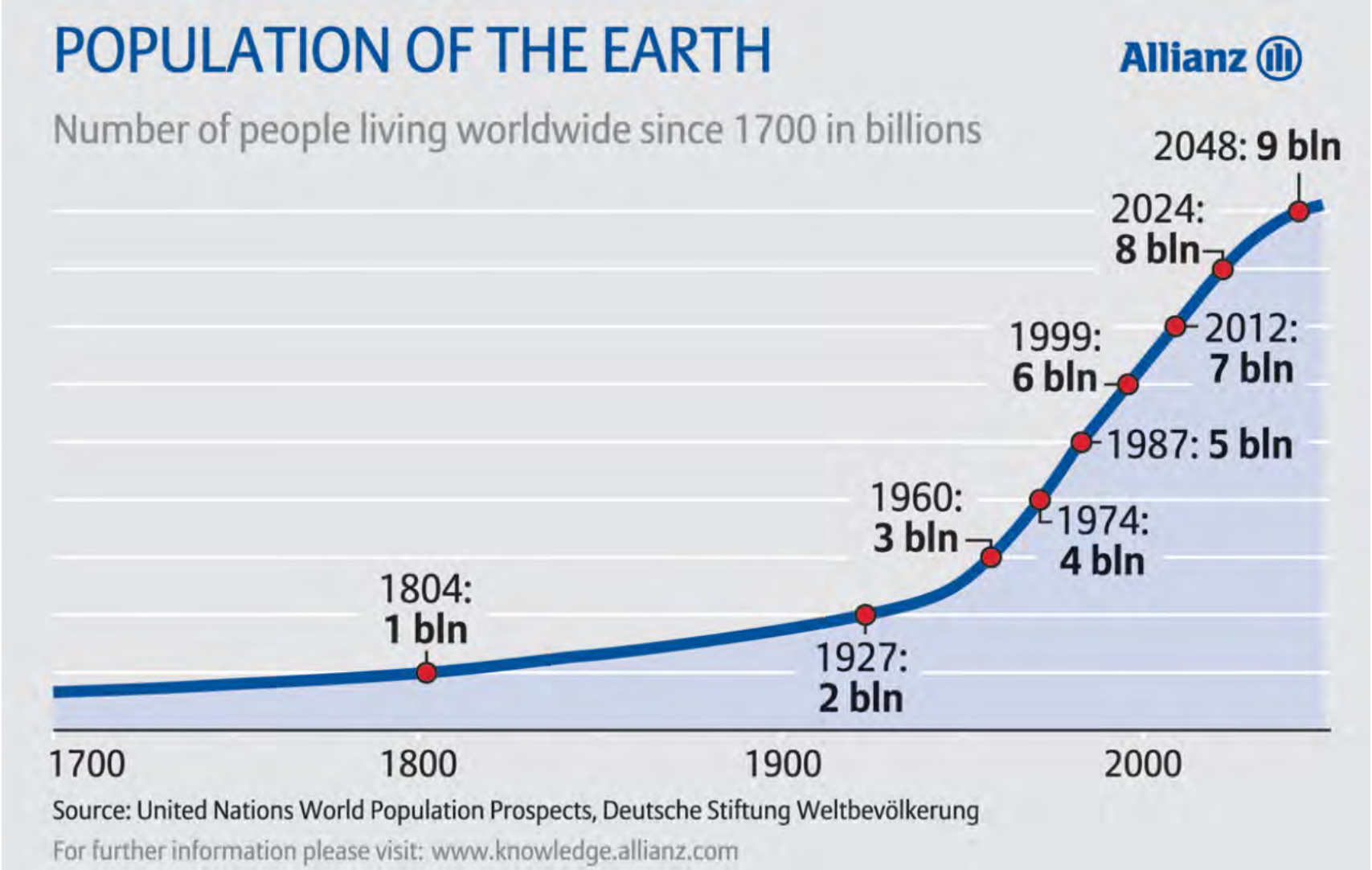
Global Context :

- Population Growth
- Urbanization
- Globalization
- Customization
- Business models change

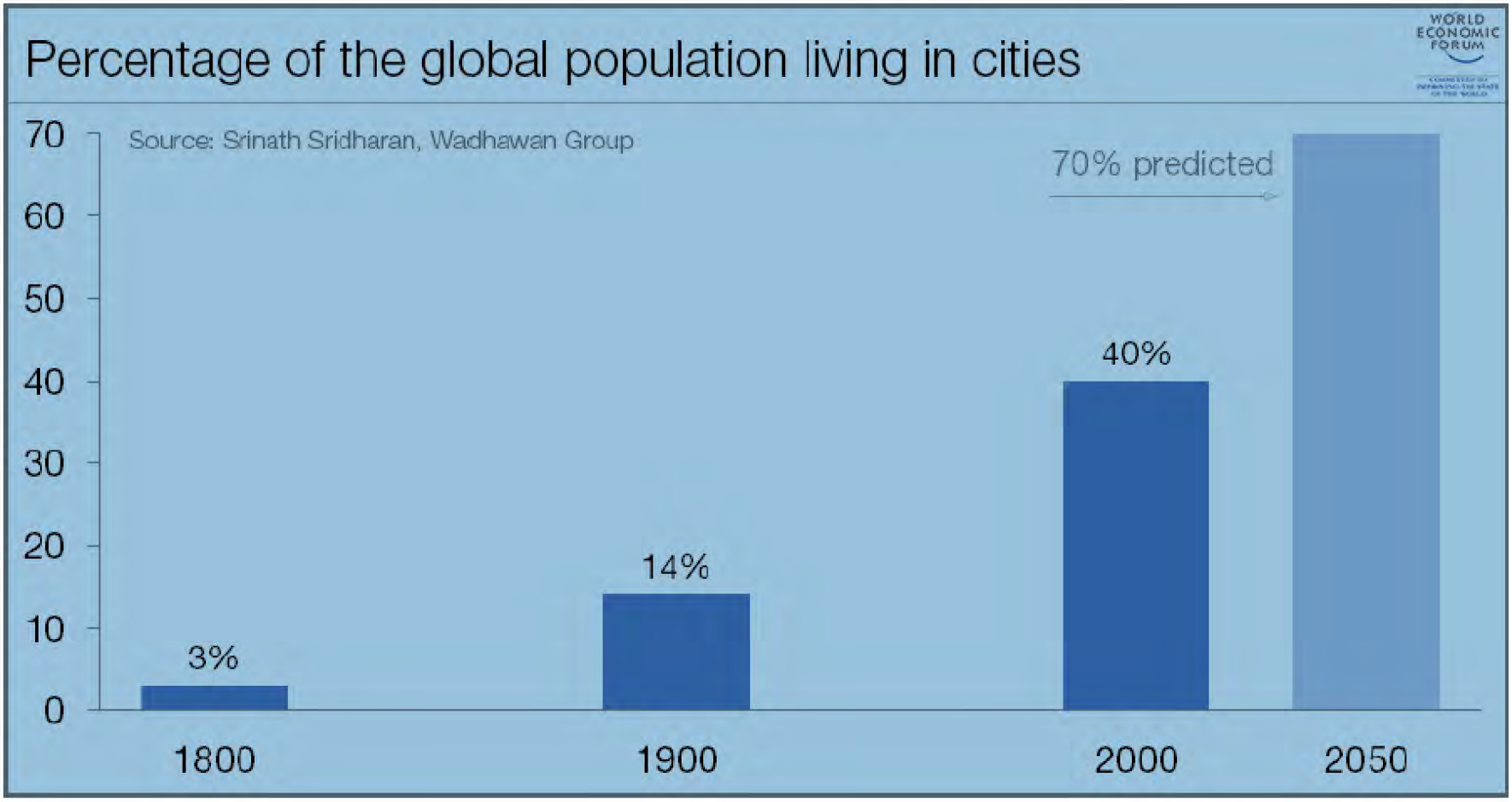
Specific Context :

- Exponential growth (Moore's law)
- Virtualization
- Connectivity
- Mobility
- IoE
- Multi-domain simulation
- Additive Manufacturing
- Singularity

Population of the Earth



Urbanization



NAE Grand Challenges 2020

1. Make solar energy economical
2. Provide energy from fusion
3. Develop carbon sequestration methods
4. Manage the nitrogen cycle
5. Provide access to clean water
6. Restore and improve urban infrastructure
7. Advance health informatics
8. Engineer better medicines
9. Reverse-engineer the brain
10. Prevent nuclear terror
11. Secure cyberspace
12. Enhance virtual reality
13. Advance personalized learning
14. Engineer the tools of scientific discovery

Improve Energy Production

Improve the Environment

Improve Health Care

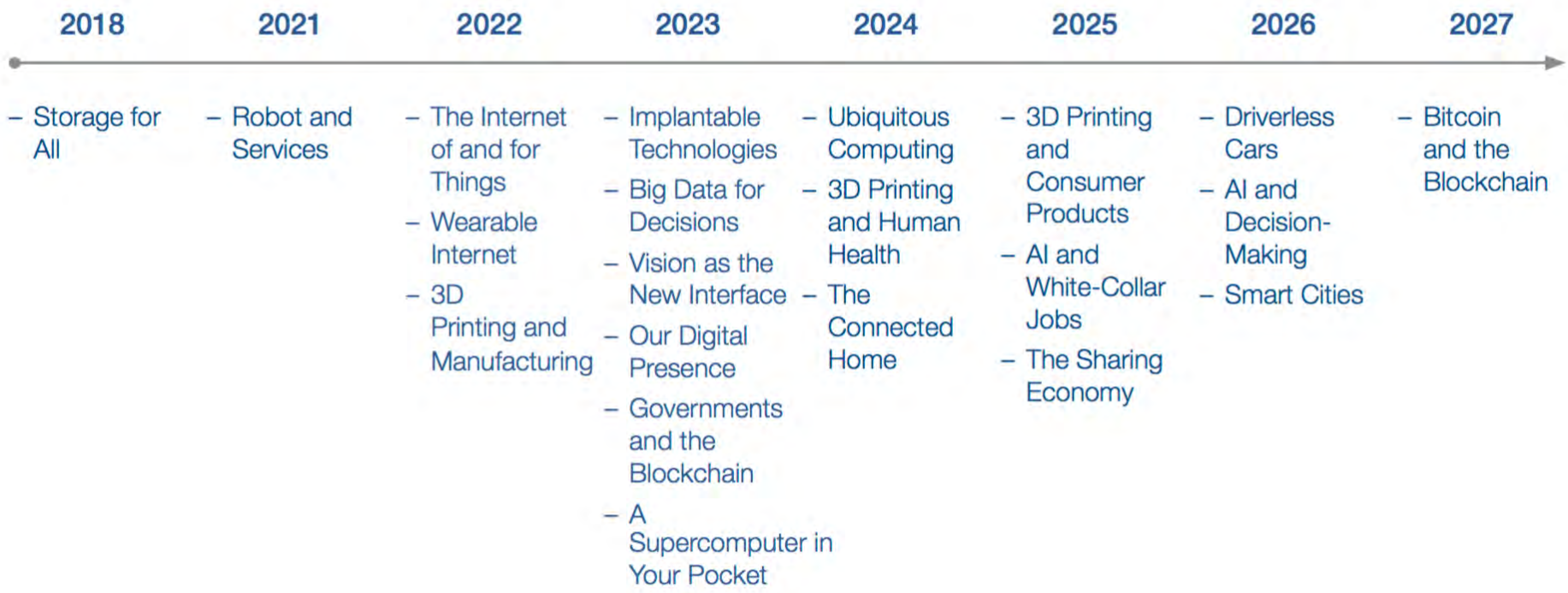
Improve Security

Improve Learning and Discovery

National Academy of Engineering : Grand Challenges of Engineering 2011

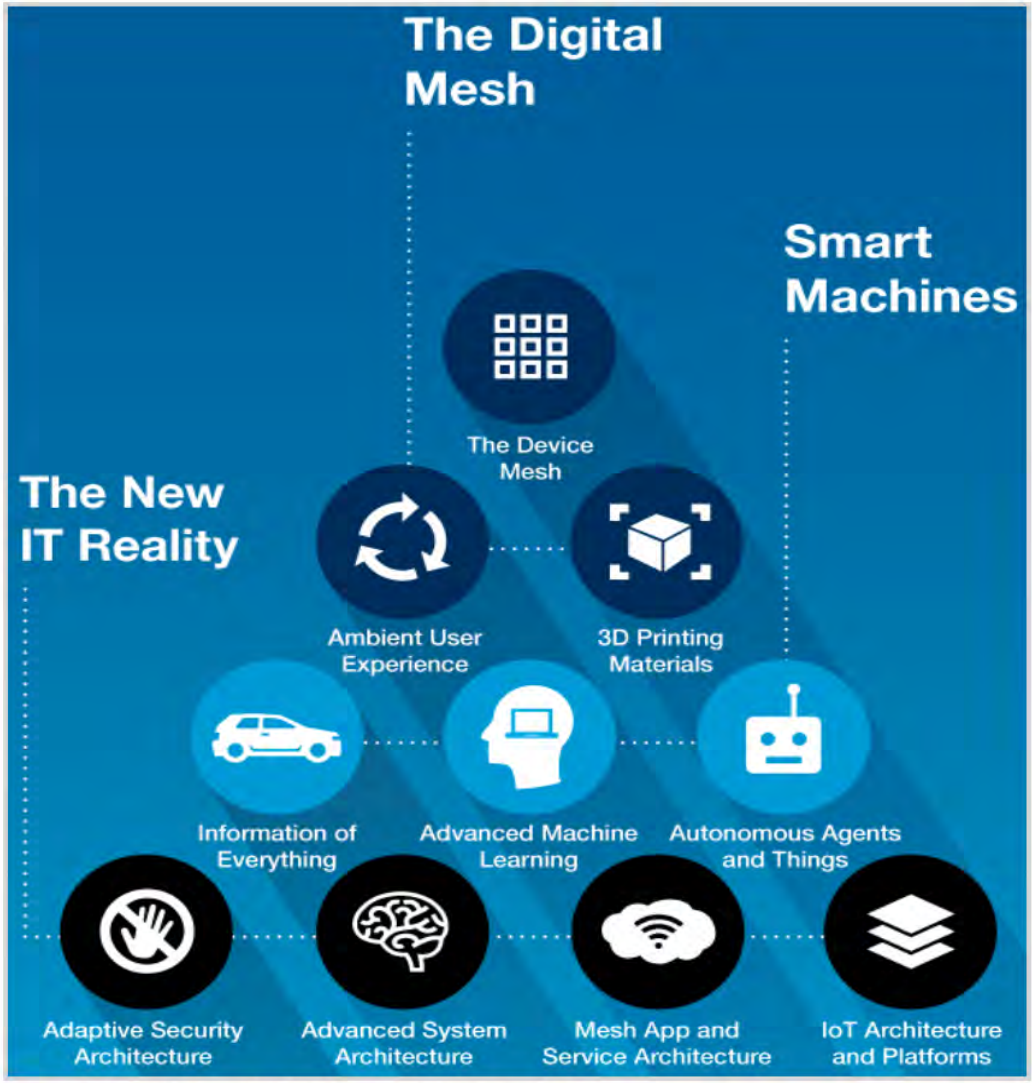
Deep Shift: Technology tipping points and Societal Impact (WEF 2015)

Figure 1: Average Year Each Tipping Point Is Expected to Occur [1]



Top 10 Strategic Trends (Gardner)

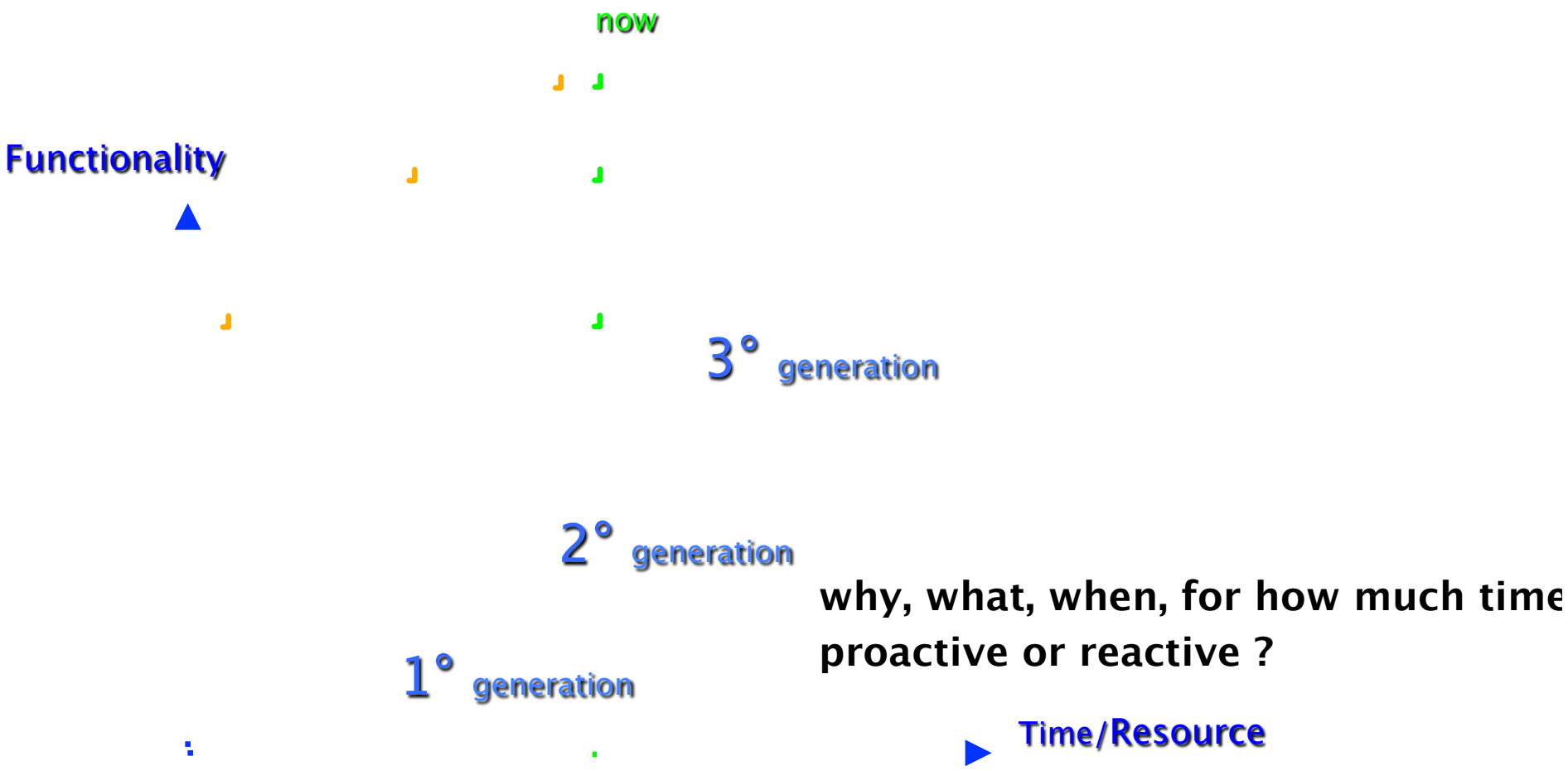
October 8, 2015



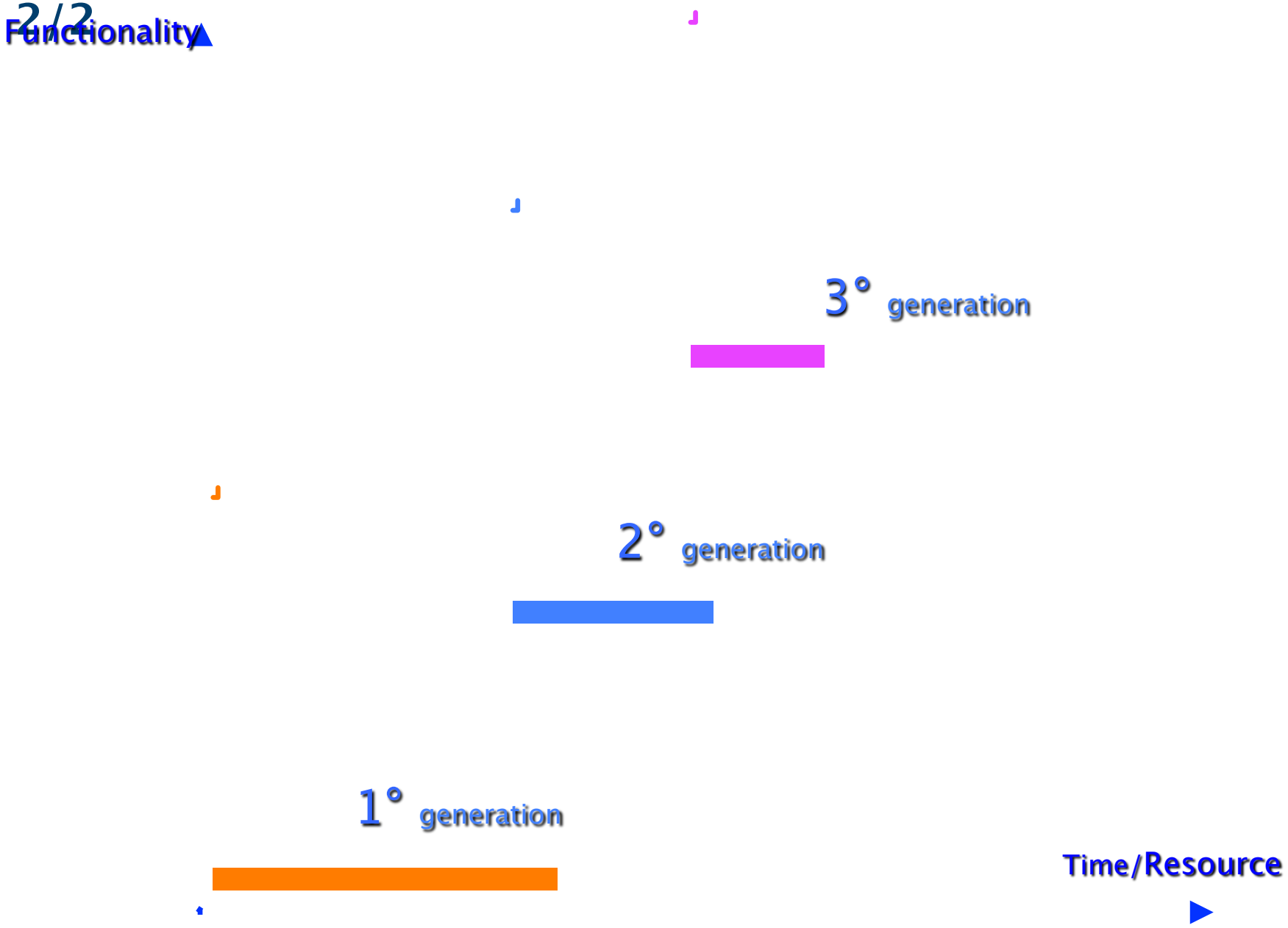
Top 10 strategic trends 2016 (credit: Gartner, Inc.)

I cicli evolutivi

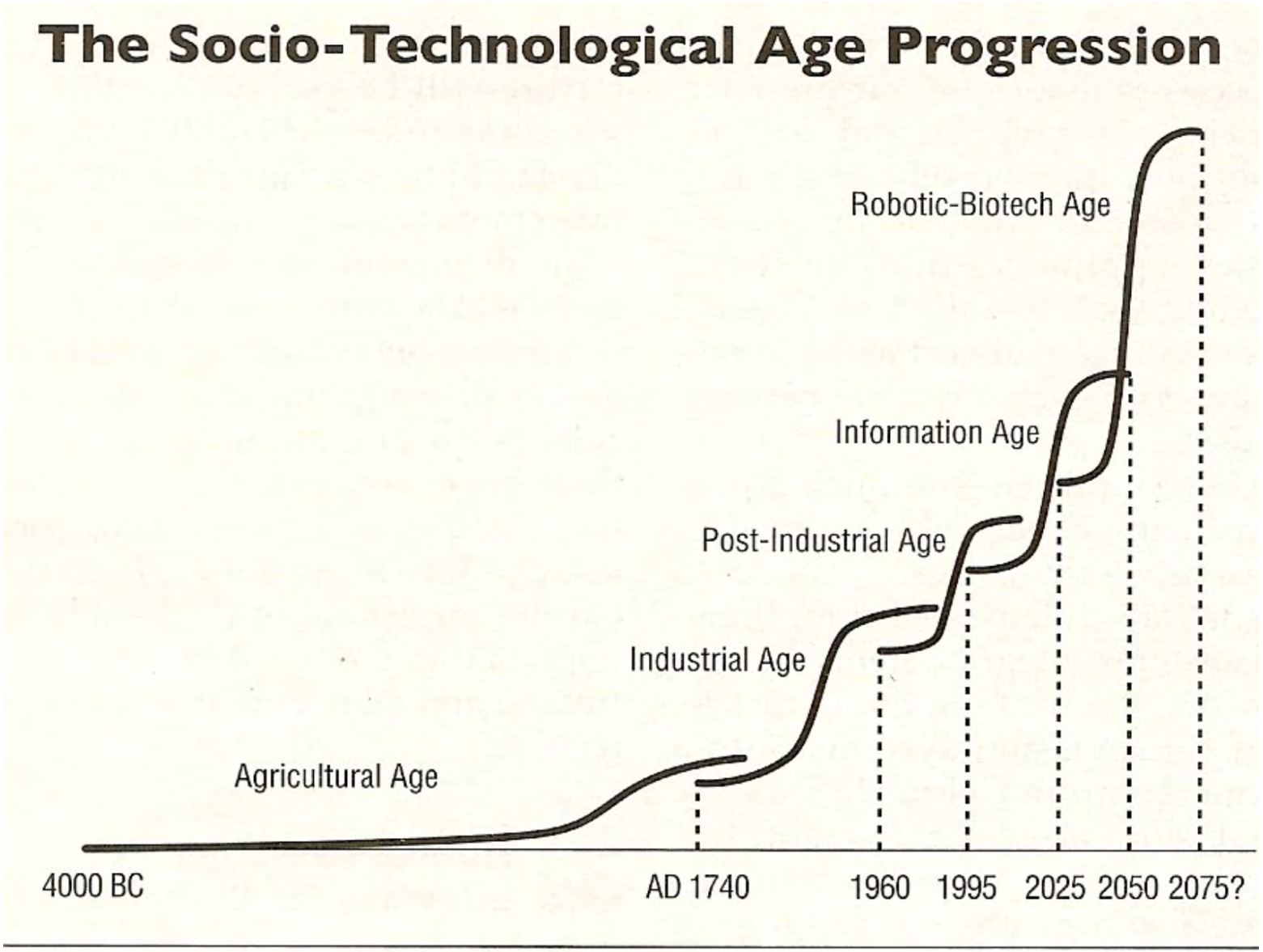
Il pattern S delle generazioni tecnologiche 1/2



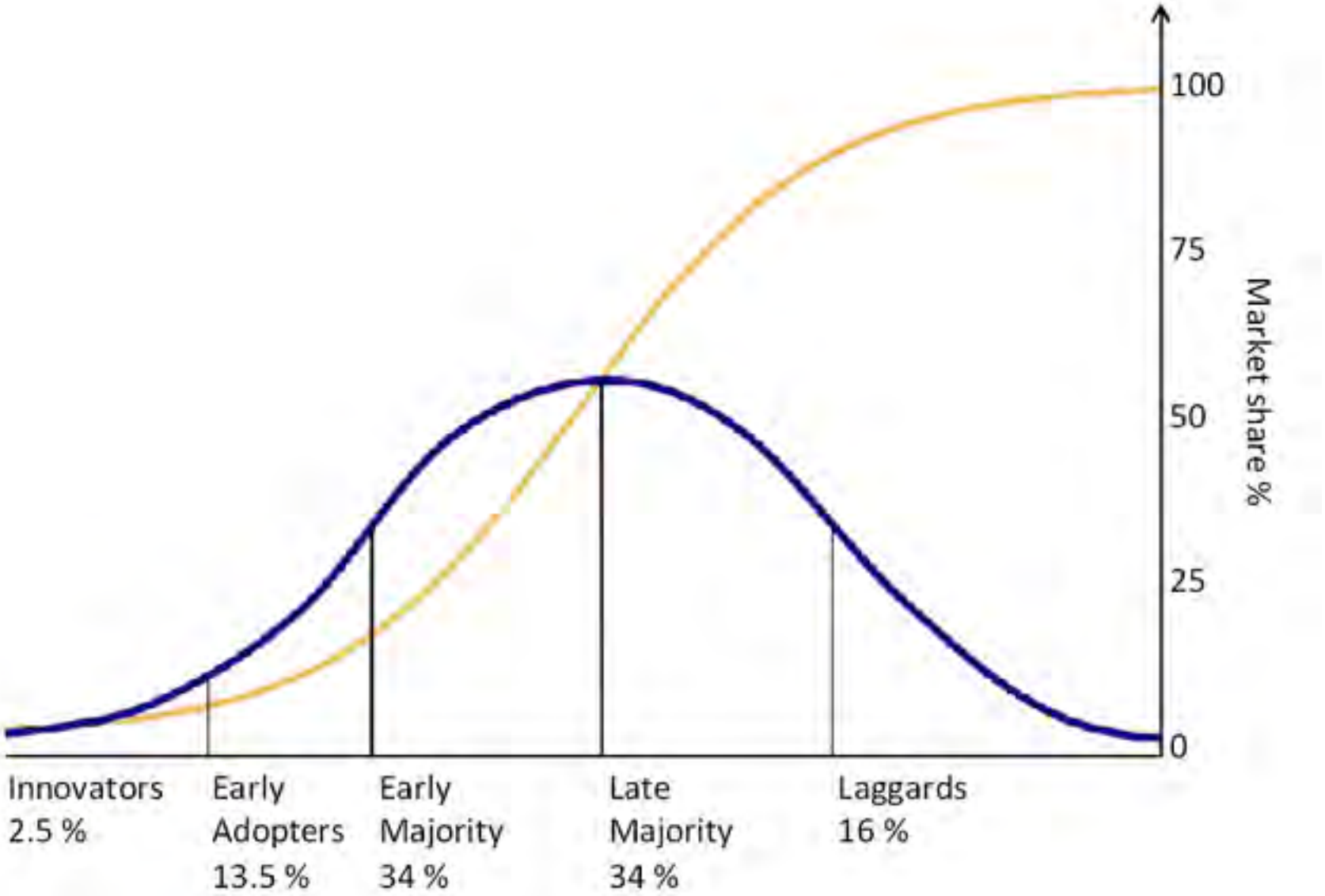
Il pattern S delle generazioni tecnologiche 2/2



Un esempio : Le ere Socio – Tecnologiche



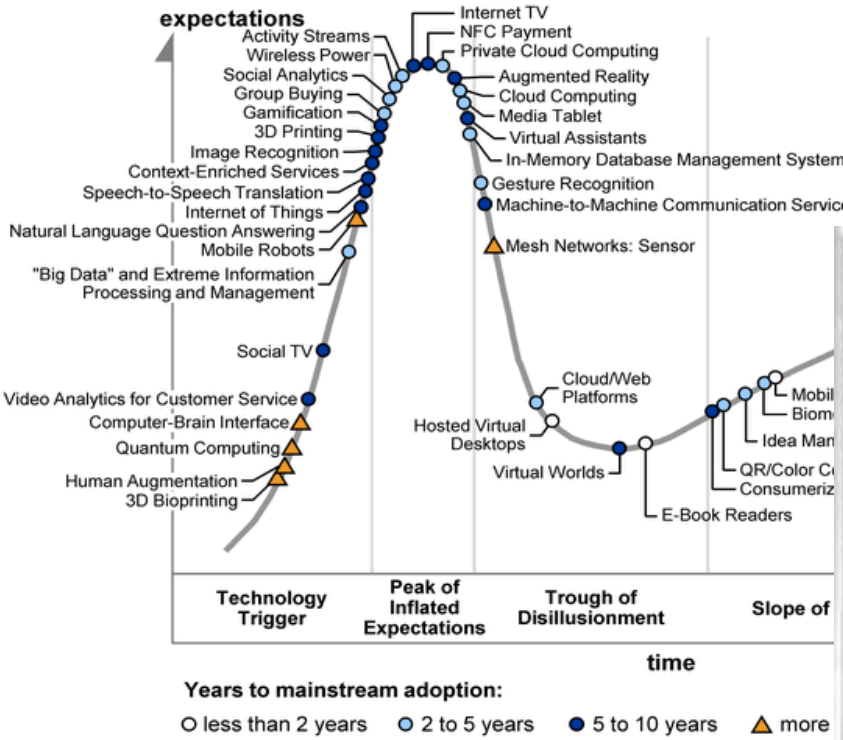
Rogers's Market Segments



Ref. E.Rogers *"Diffusion of Innovation*

Cambiano modello di diffusione e business model

From **Hype** ……



….to **shark fin**

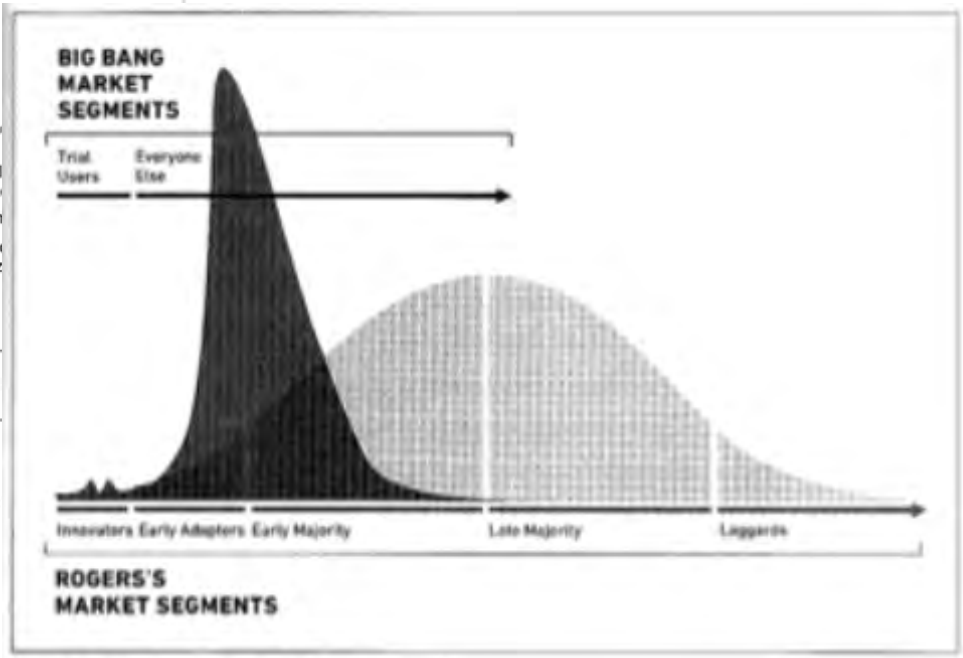
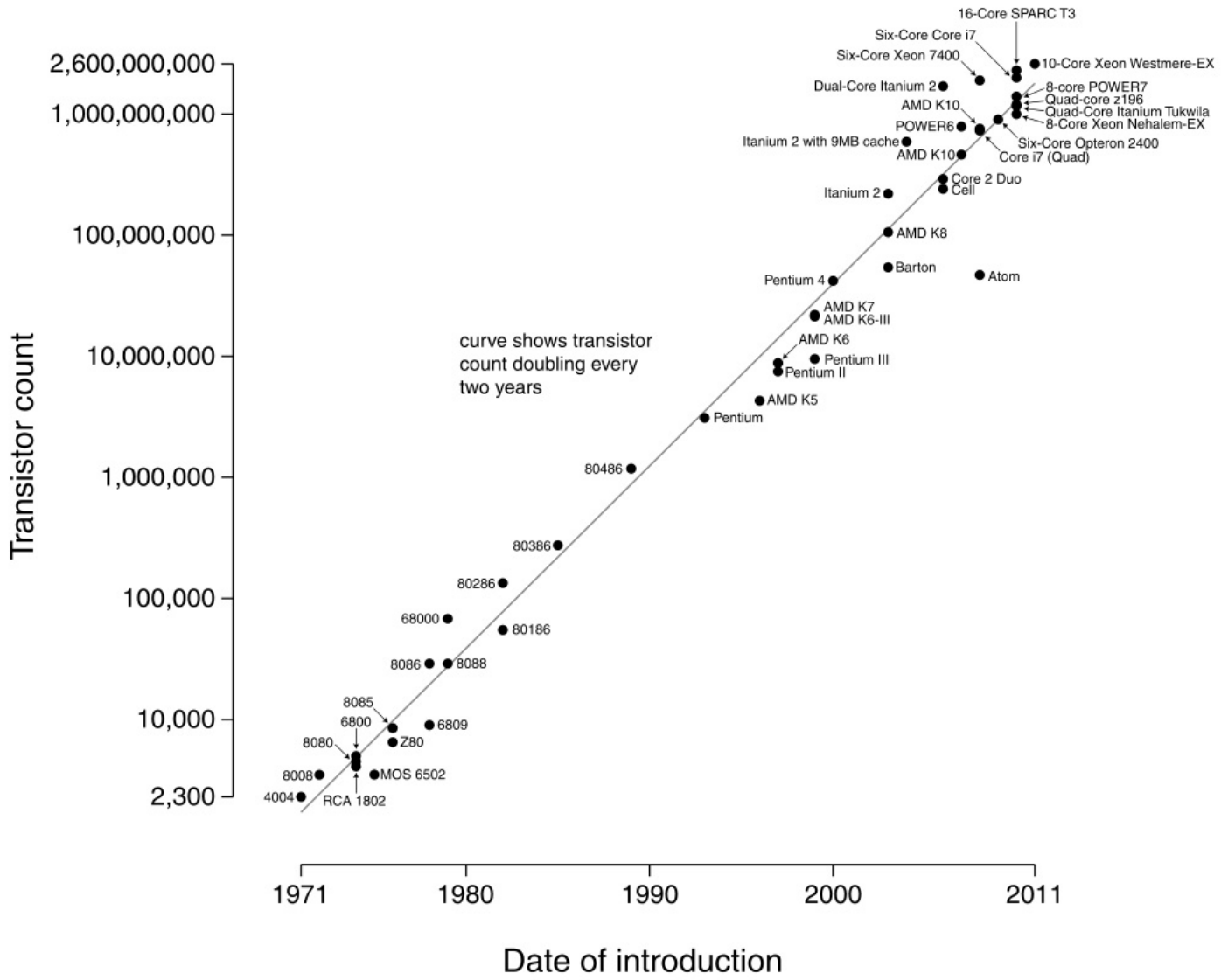


FIGURE 4. Big Bang Market Adoption

From : Larry Downes and Paul Nunes "BIG BANG Disruption"

La mitica "Moore's Law"



Ray Kurzweil

"The Law of Accelerating Returns", 2001

http://www.kuzweilai.net/the-law-of-accelerating-

"The Singularity is near", Viking 2005

"How to create a mind", Viking 2012

2014 Head of Engineering @ GOOGLE

Kurzweil Accelerating Intelligence

- http://www.kurzweilai.net

Singularity University

- http://singularityu.org

Ray Kurzweil talks

Big Think: The Coming Singularity (Apr 28, 2009)

- https://youtu.be/1uIzS1uCOcE

Talk at Google, (July 1, 2009)

- https://youtu.be/43zo82W7aPI

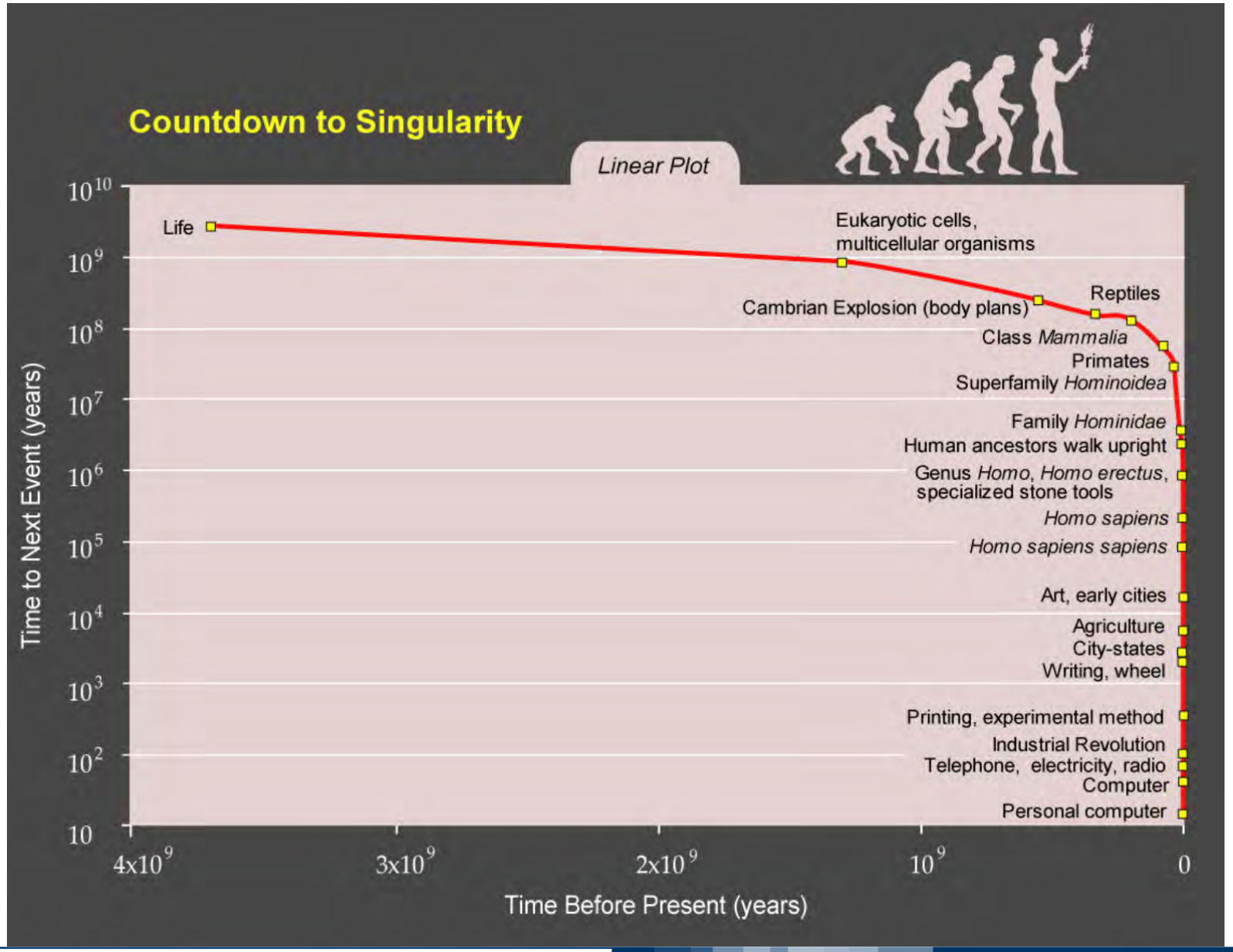
Keynote at the first Executive Program at Singularity University, (Nov 16, 2009)

- https://youtu.be/bis0euOhy58

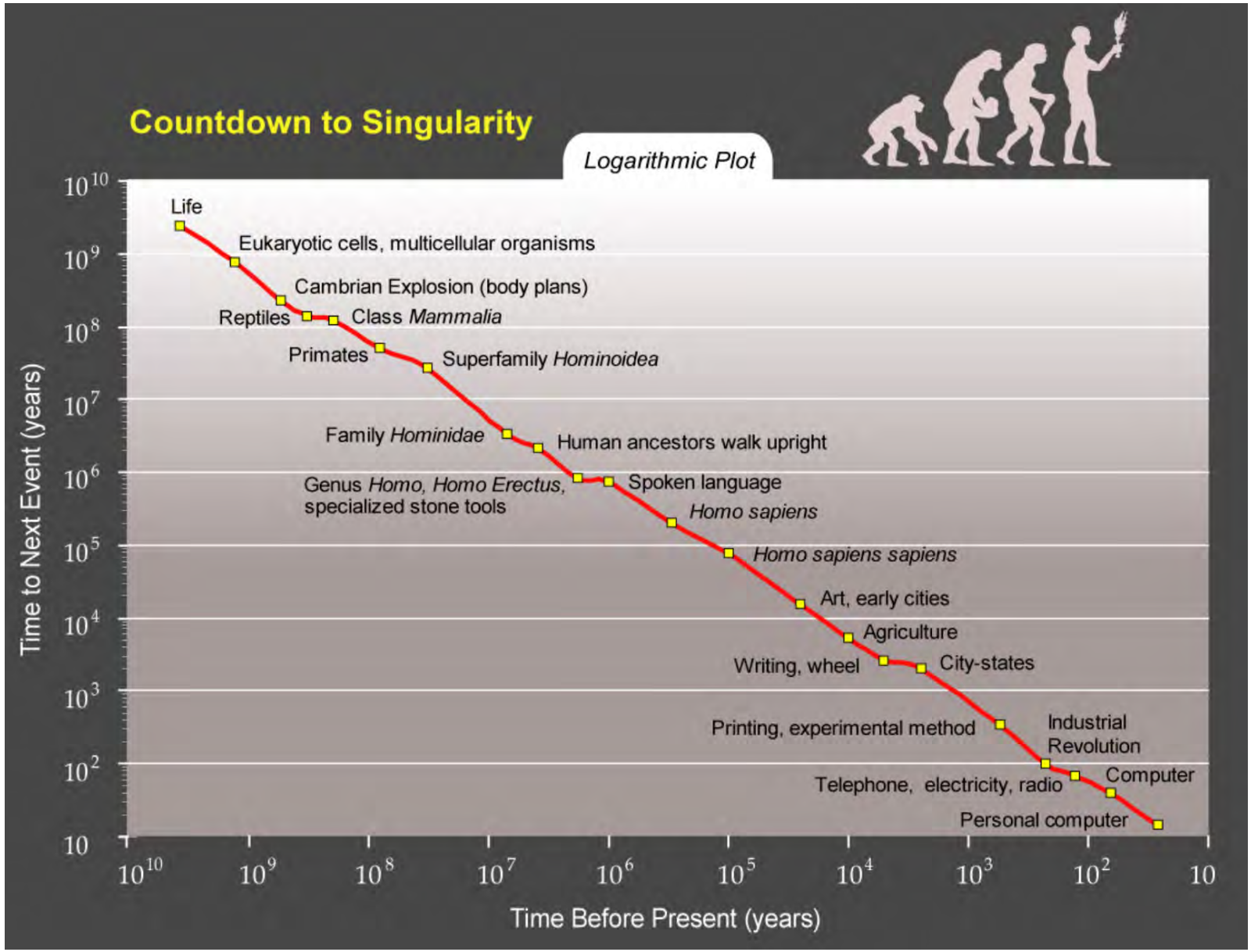
TED Talks: Get ready for hybrid thinking, (Jun02, 2014)

- https://youtu.be/PVXQUItNEDQ

Evoluzione storica (base lineare)



Evoluzione storica (base esponenziale)

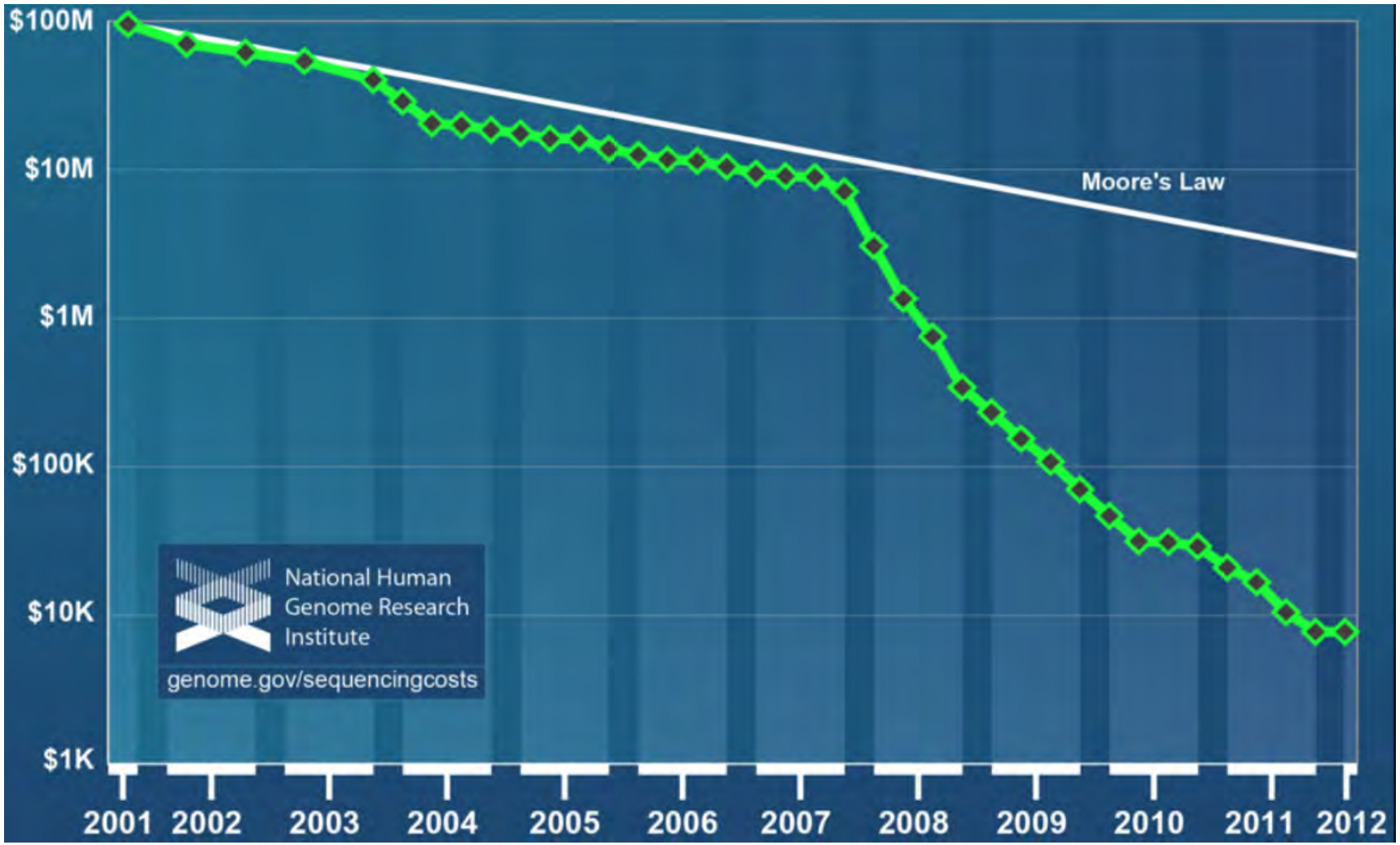


The Law of Accelerating Returns

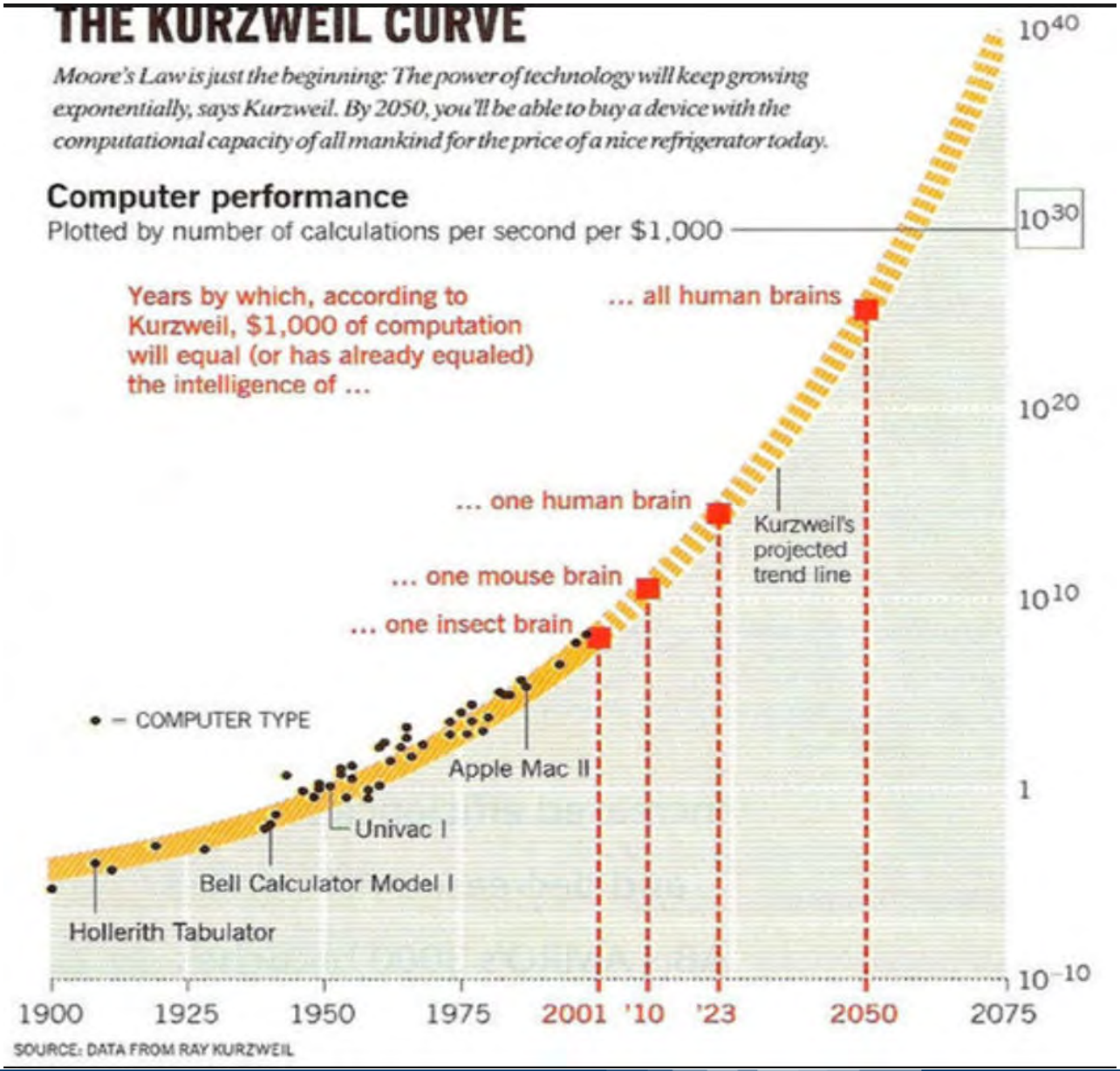
- The price-performance, capacity & bandwidth of information technologies progresses exponentially through multiple paradigm shifts
  - Specific to information technology
    - not to arbitrary exponential trends (like population)
    - Still need to test viability of the next paradigm
  - A scientific theory
    - 25 years of research
    - Part of a broader theory of evolution
    - Inventing: science and engineering
  - Moore's law just one example of many
  - Yes there are limits
    - But they're not very limiting
      - Based on the physics of computation and communication
      - and on working paradigms (such as nanotubes)

http://www.kuzweilai.net/the-law-of-accelerating

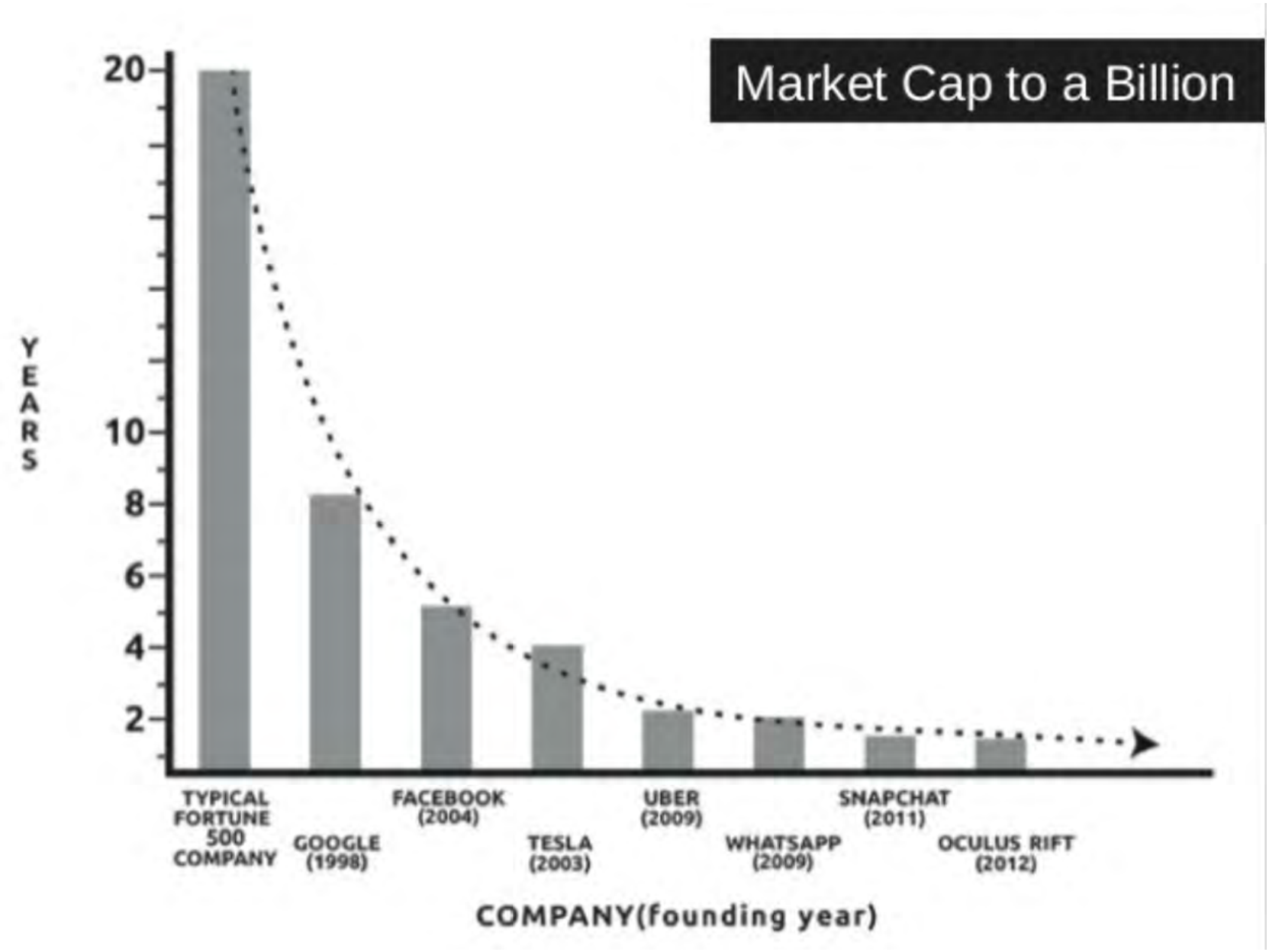
Exponential evolution nella biologia



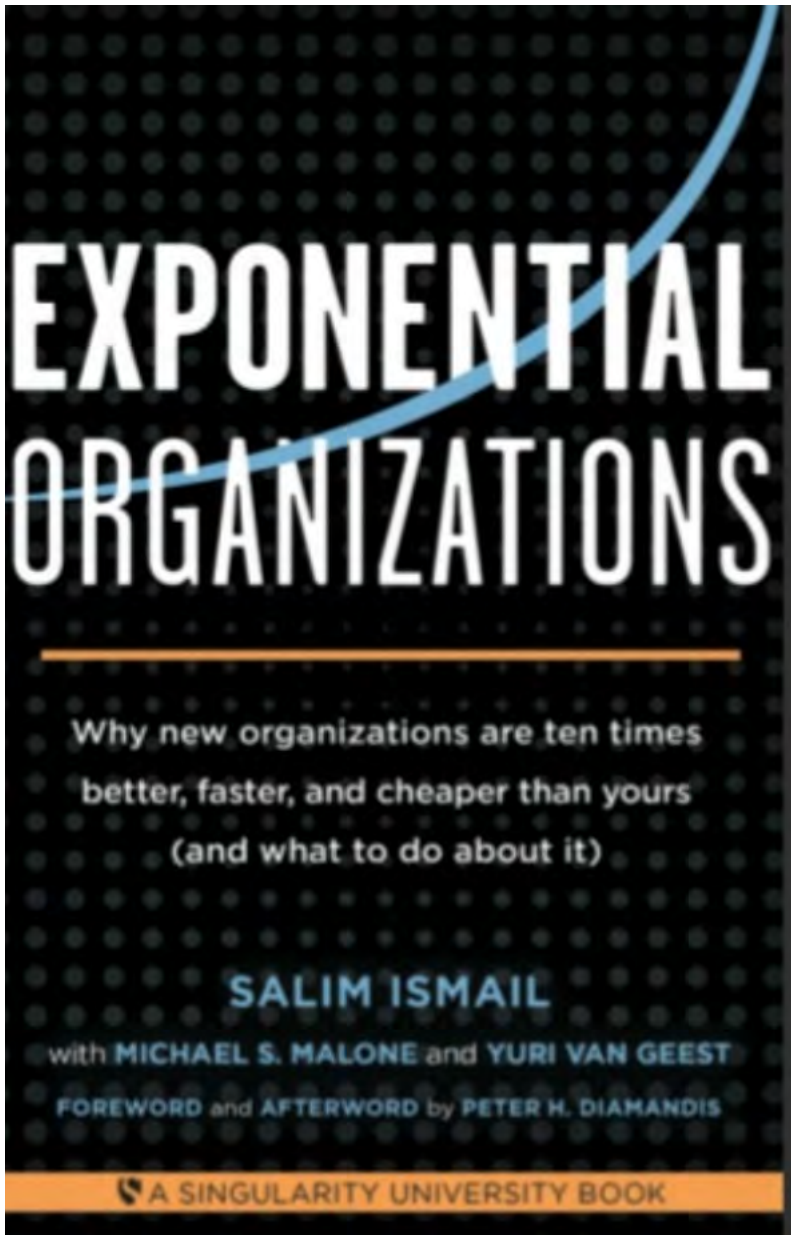
The Kurzweil Curve



Market Cap

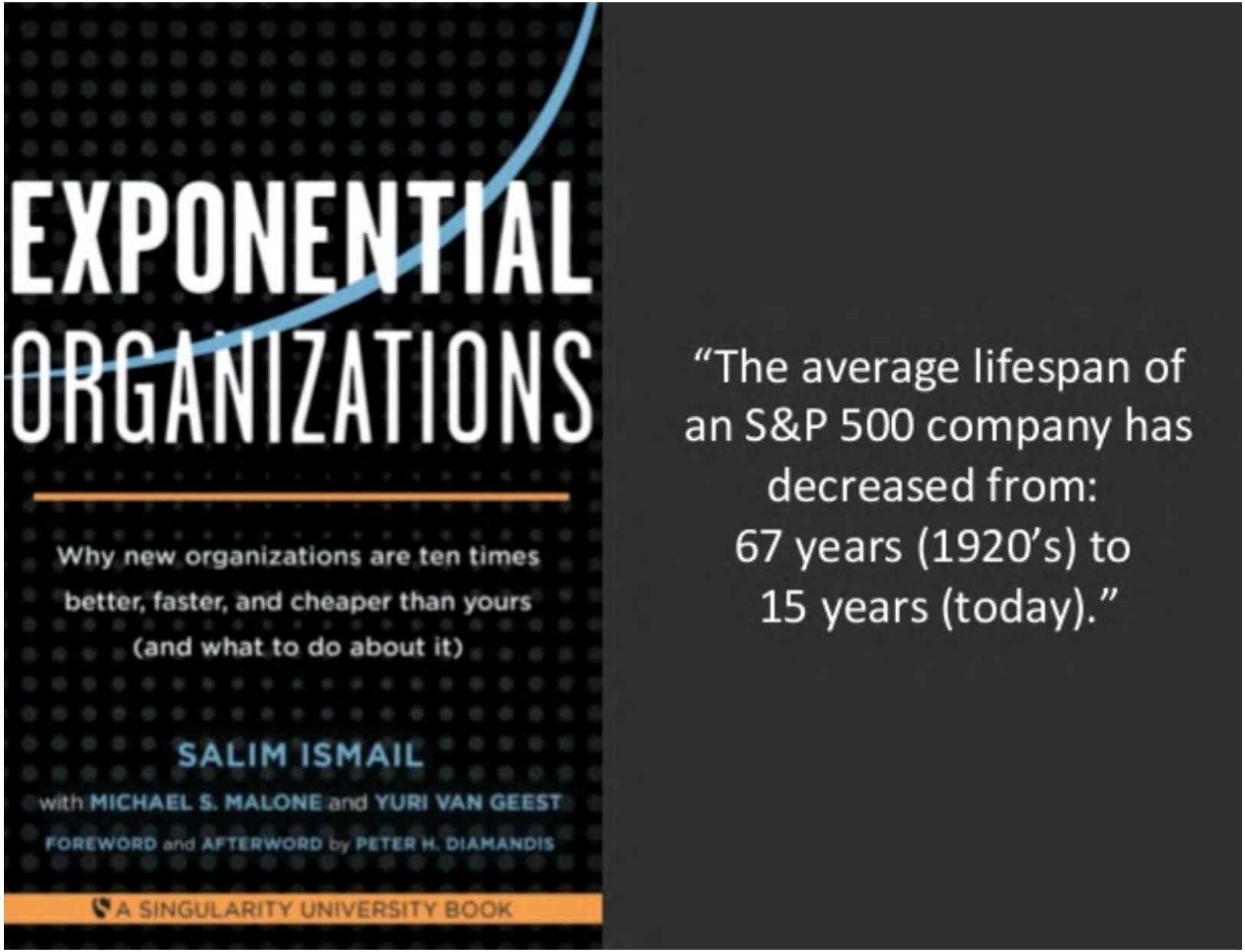

Market Cap to a Billion
YEARS
20
10
8
6
4
2
TYPICAL FORTUNE 500 COMPANY
GOOGLE (1998)
FACEBOOK (2004)
TESLA (2003)
UBER (2009)
WHATSAPP (2009)
SNAPCHAT (2011)
OCULUS RIFT (2012)
COMPANY(founding year)

Singularity Univerity book

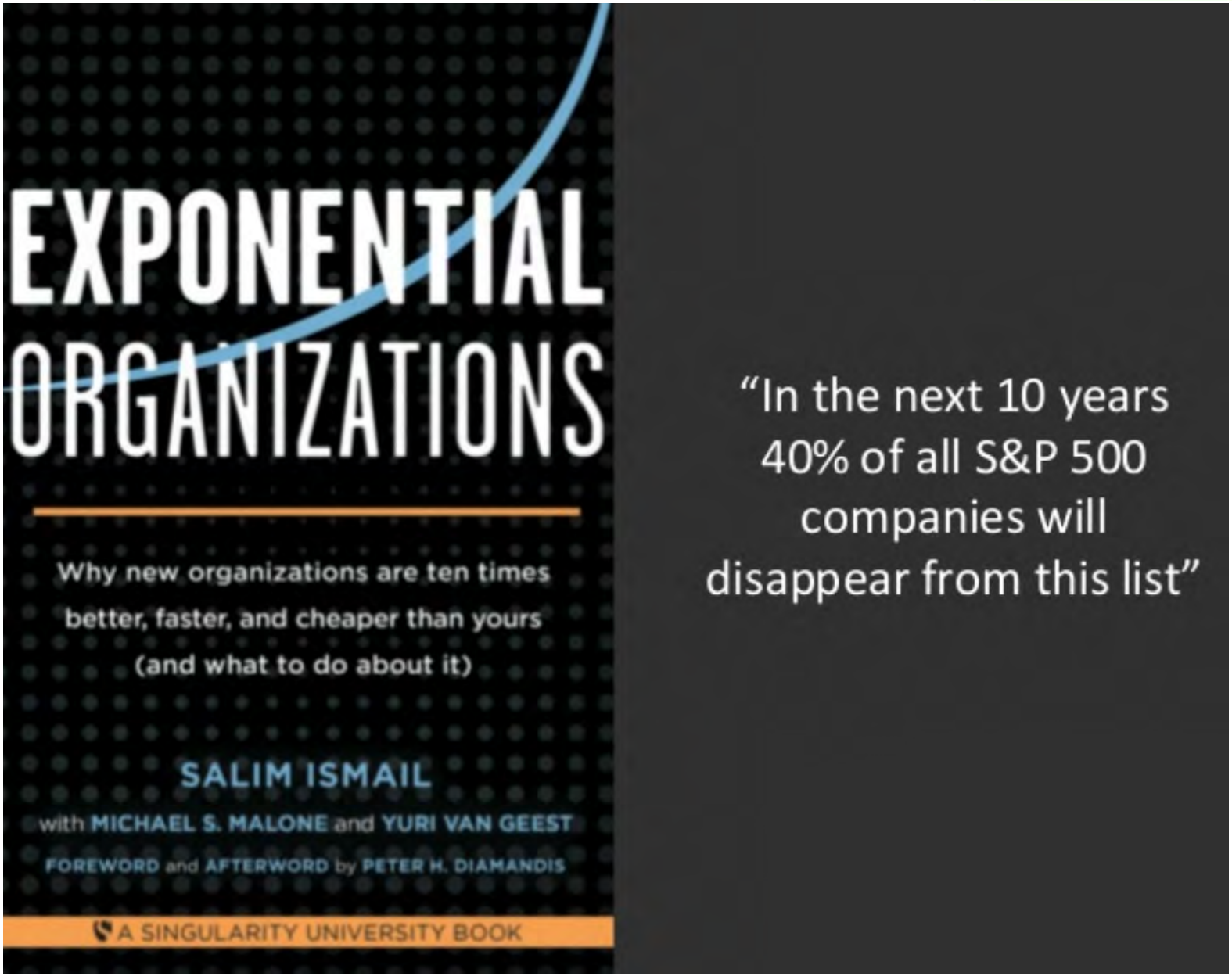


"The average half life of a business competency has dropped from 30 years in 1984 to 5 years in 2014."

Singularity Univerity book



Singularity Univerity book



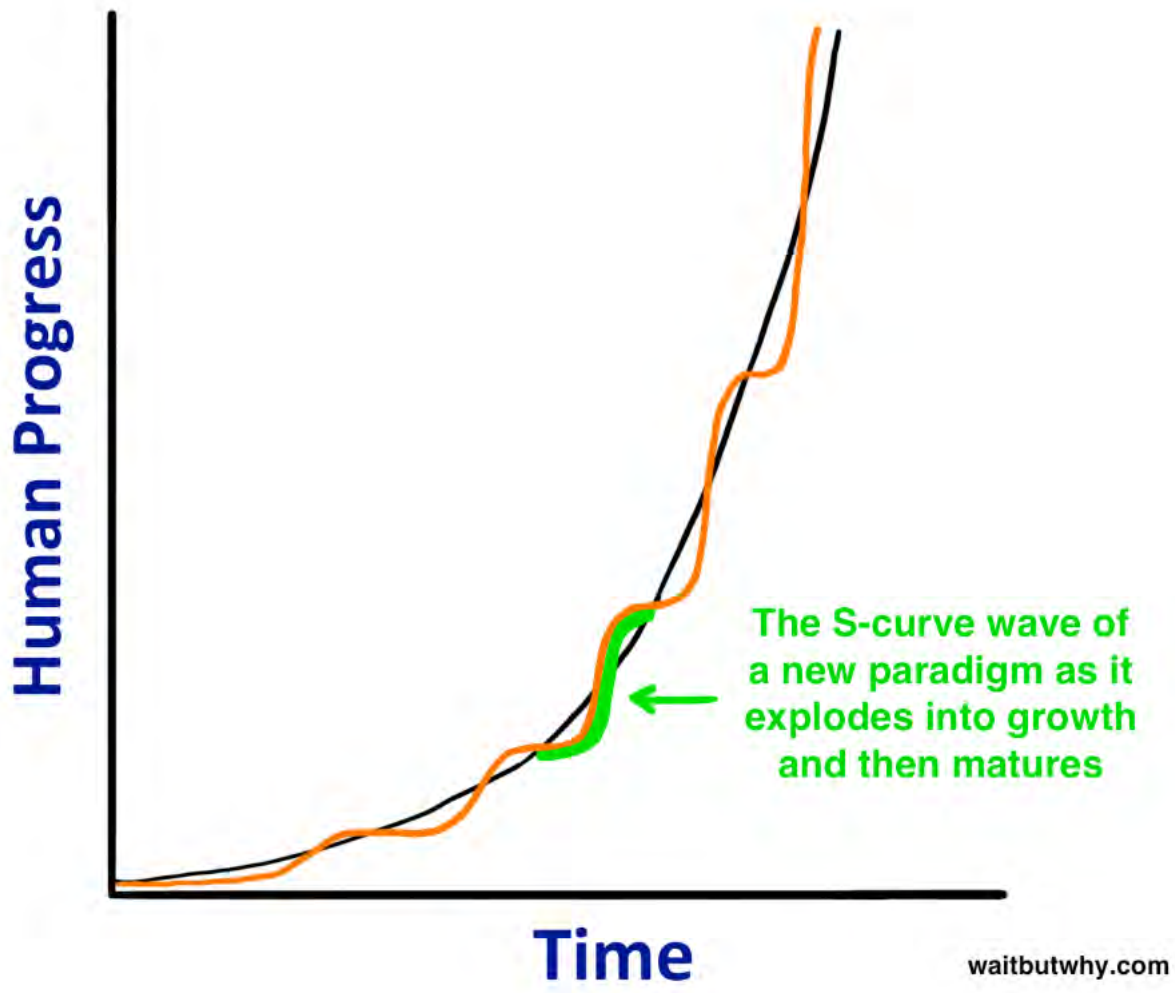
Quali i veri problemi

- Cambio di velocità del cambiamento

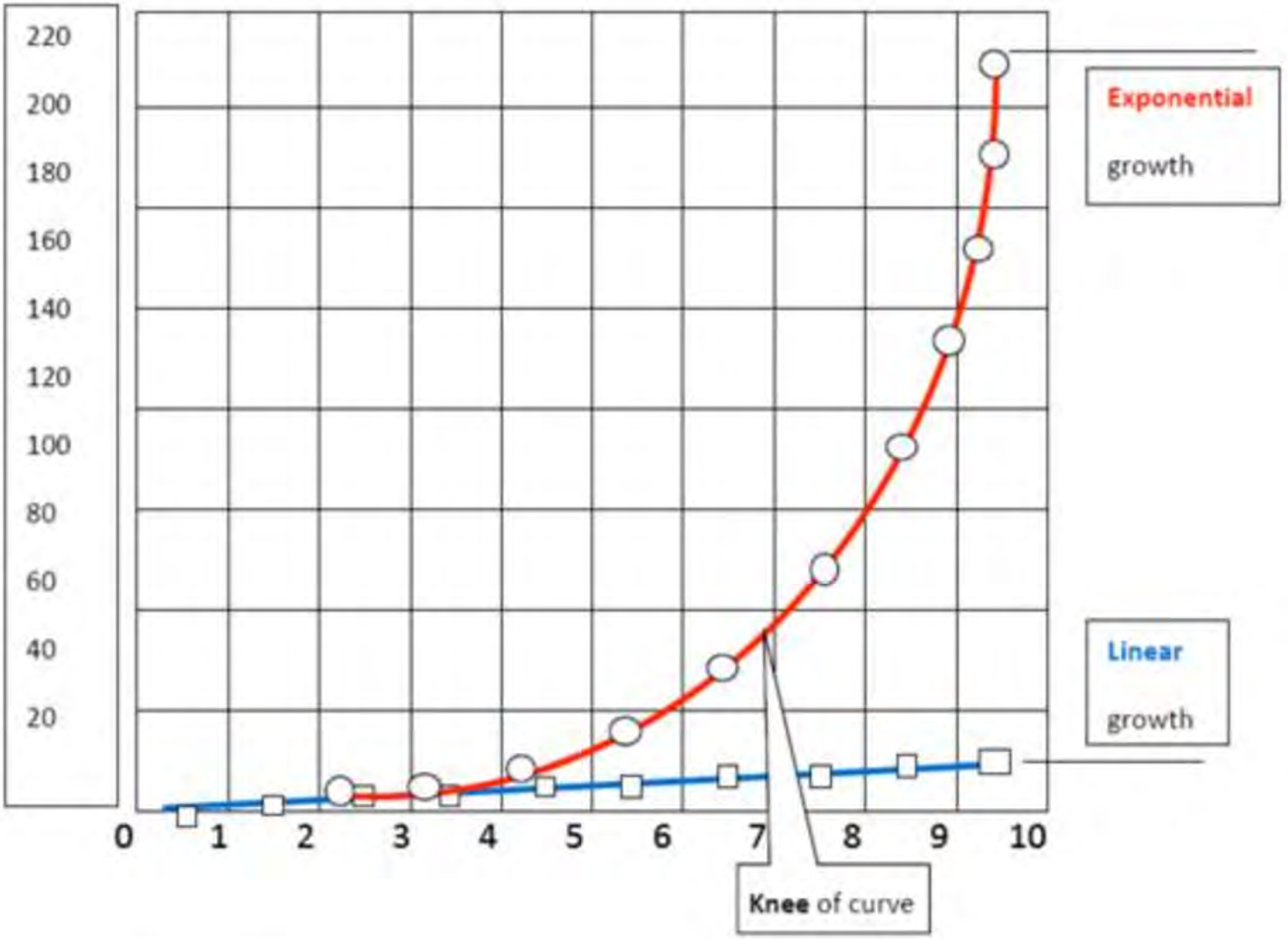
- Da > della vita professionale …
  … a < e via via a << della vita professionale

- Da generazioni …
  … 1.0, 2.0, 3.0, 4.0 …
  … a continuo e/o a disruption

Come avviene l'evoluzione

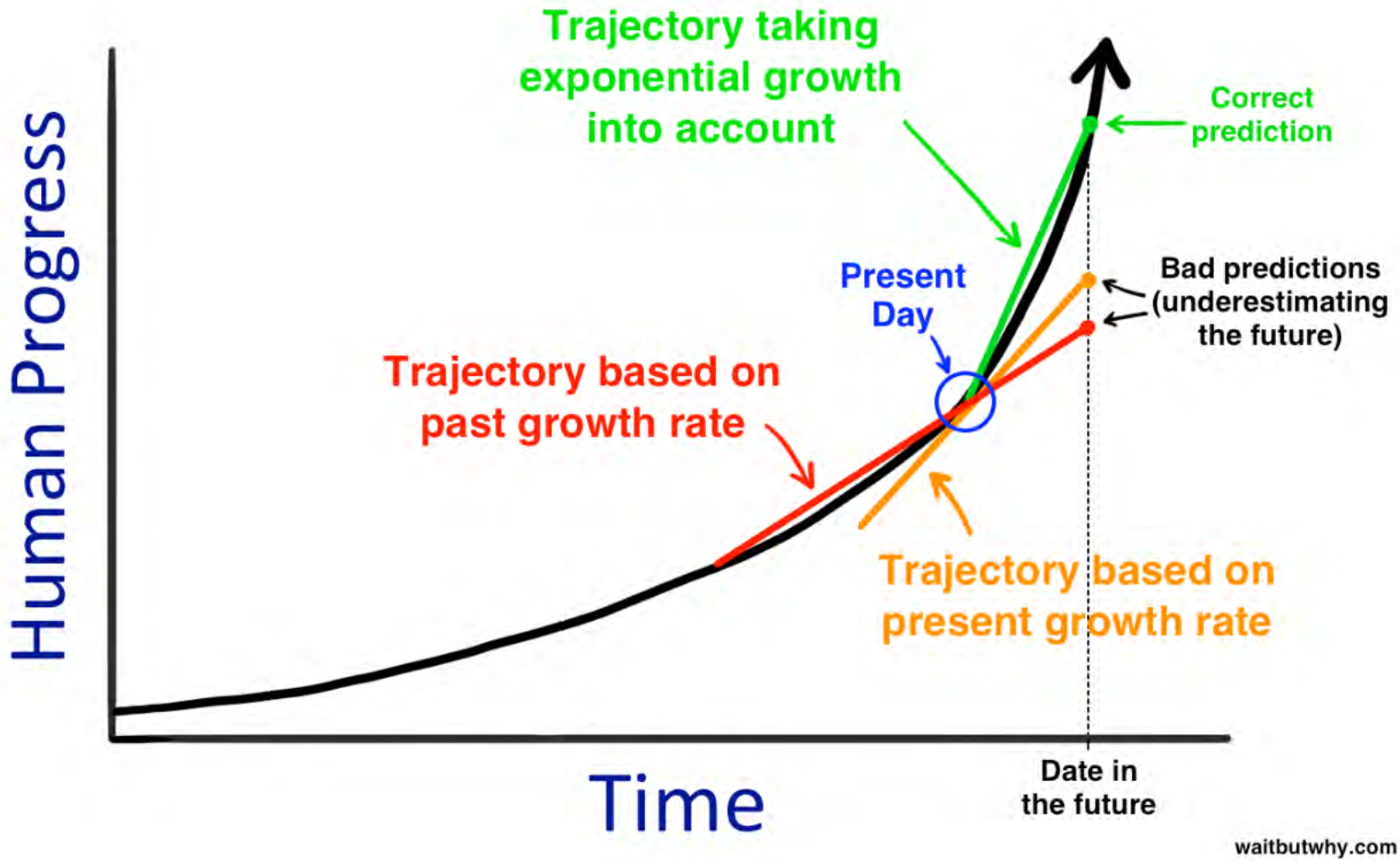


Linear vs. Exponential

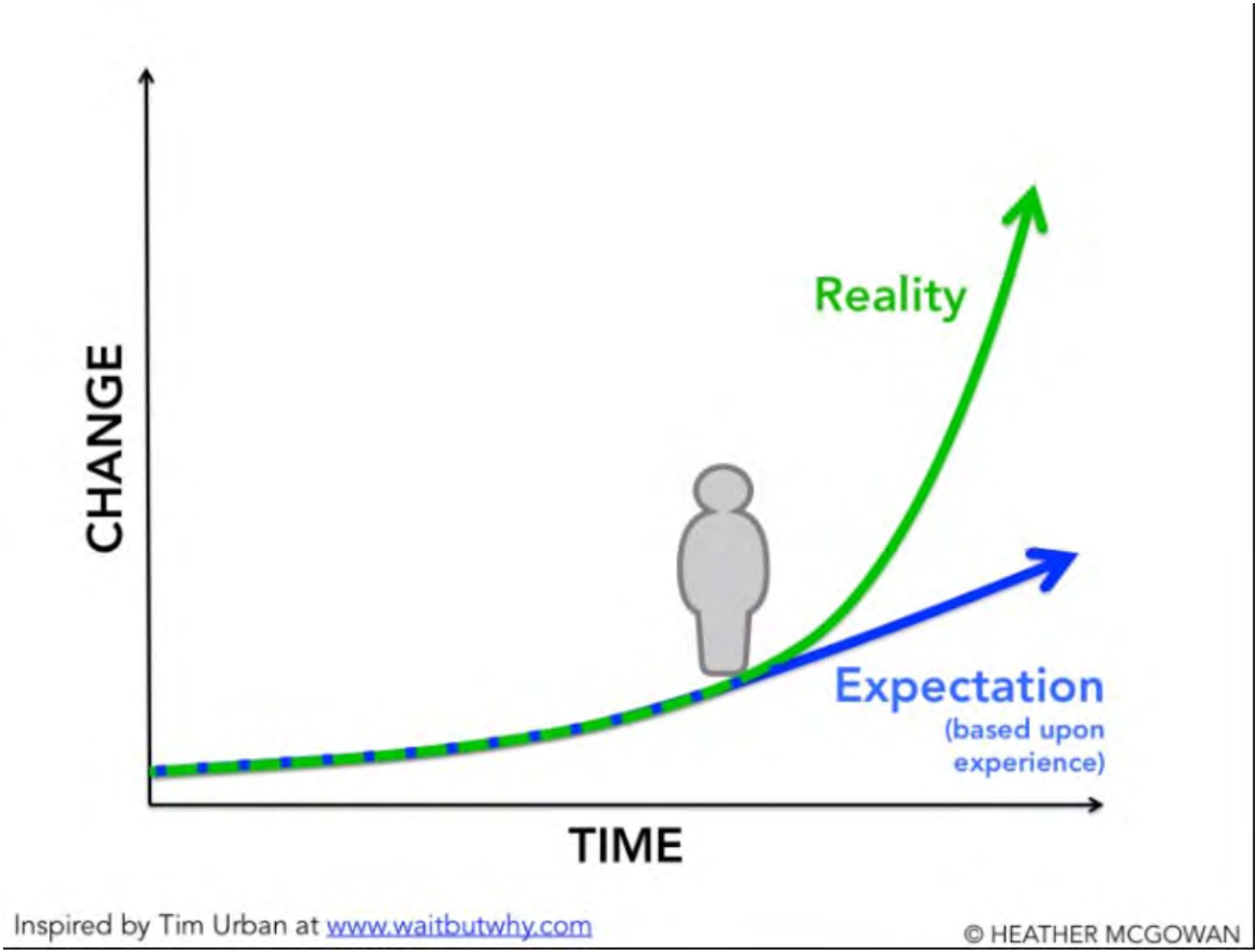


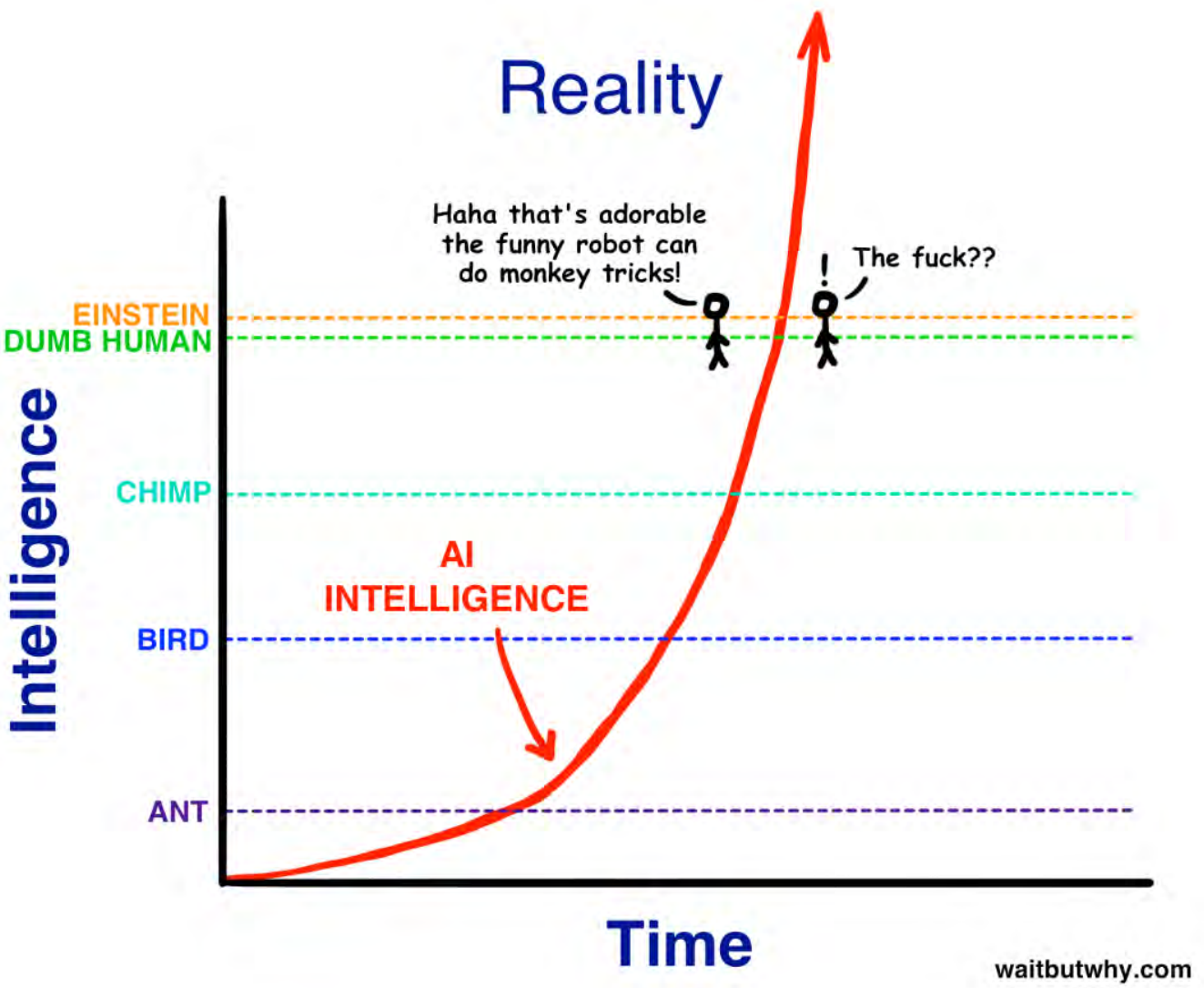
Adopted from Kurzweil

Noi ragioniamo in modo lineare…

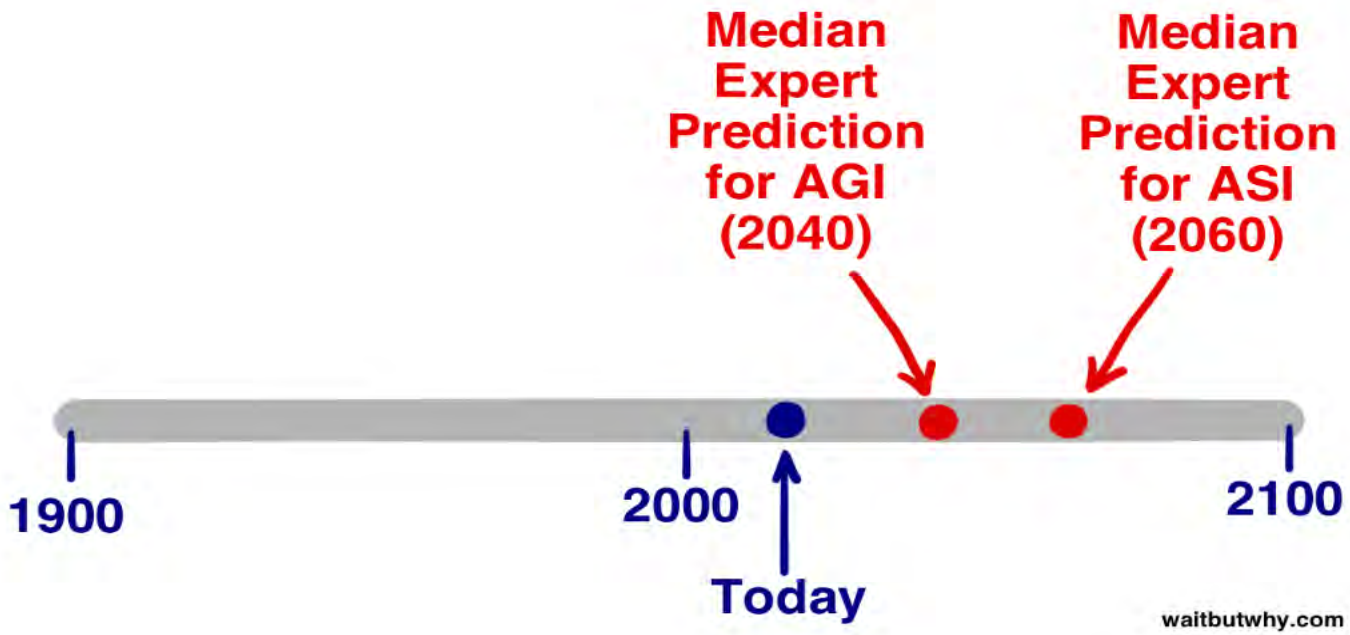


Come facciamo le previsioni (lineari)



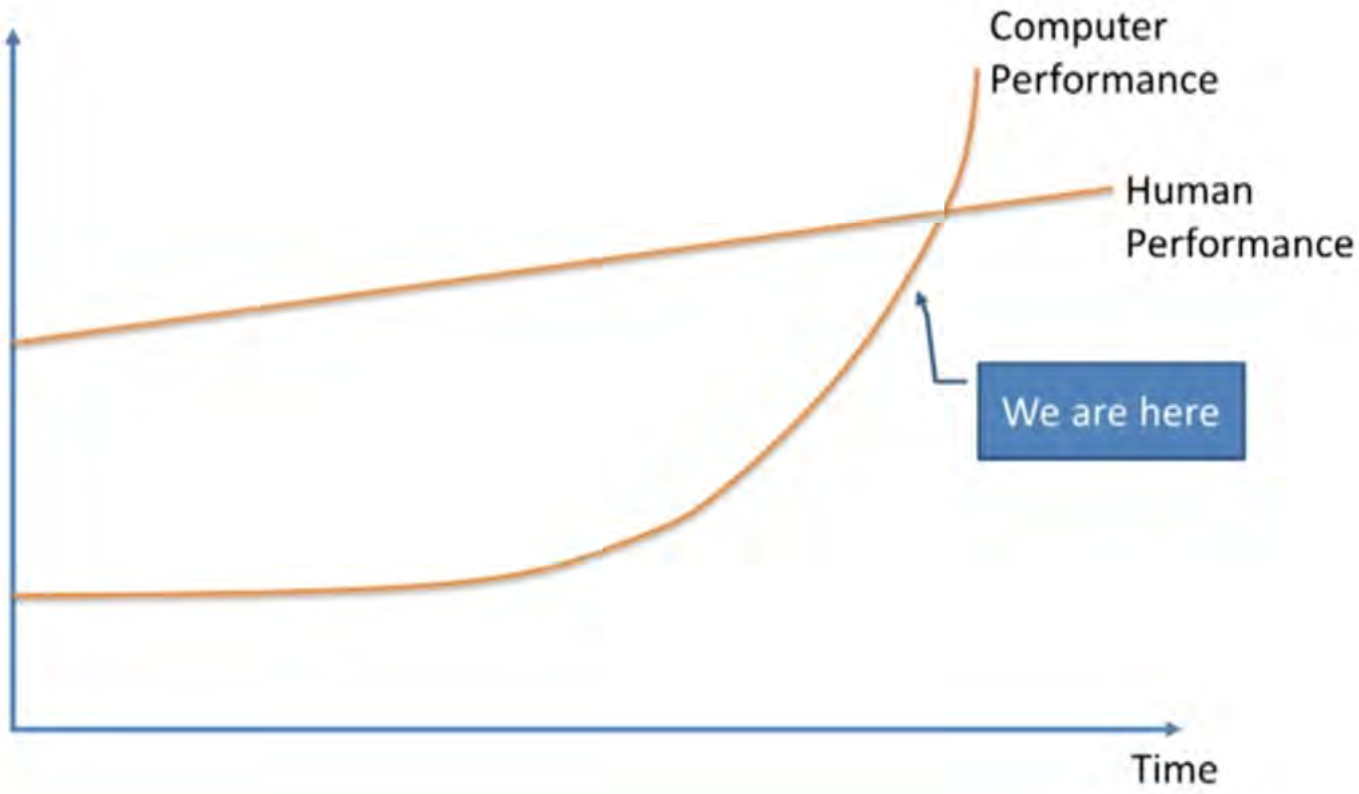

Reality
Haha that's adorable the funny robot can do monkey tricks!
The fuck??
EINSTEIN
DUMB HUMAN
CHIMP
AI
INTELLIGENCE
BIRD
ANT
Intelligence
Time
waitbutwhy.com

ANI Artificial Narrow Intelligence
AGI Artificial General Intelligence
ASI Artificial SuperIntelligence



Come affrontarli

Oggi siamo qui, e quindi?



Torniamo alla situazione attuale

Un osservazione iniziale :

Una volta si progettavano, fabbricavano e poi vendevano:

- **Macchine**

Poi …

- **Sistemi**

Poi …

- **Prodotti**

Oggi ...

- **Servizi**

Domani …

- **Accesso e disponibilità**

IL PRODOTTO

Che oggi vuol dire **prodotto vincente** cioè:

- Innovativo
- Customizzato
- Facilmente usabile
- Attraente
- Emozionante

Evoluzione della progettazione

Il risultato (visto dall'utente)

- Non si rompe > Funziona bene > ***è innovativo***

L'obiettivo (visto dal progettista)

- Macchina > Sistema > ***Prodotto***

La funzione (svolta dal progettista)

- Dimensionamento > Architettura > ***Problem solving***

Il metodo

- Calcolo strutturale > System design > ***Systematic innovation***

L'attore

- Progettista > Architetto > ***Industrial Designer***

Evoluzione del processo NPD

Da **function centric** (Push) a **user/customer centric** (Pull)

Function centric

Il processo è pilotato da innovazione incrementale (che non è disruptive e non crea necessariamente nuovo mercato)

User/Customer centric

Cambio di paradigma:

Da progettare la soluzione e poi validarla …

…. a validare la soluzione e poi progettarla

Cambia la tecnologia di supporto :

- Progettazione >> CAD + CAM / AM
- Simulazione d'uso >> FMU + iVP + Multiphysics simulation

Da…

specifica di **come deve essere fatto** (**CAD**)

a…

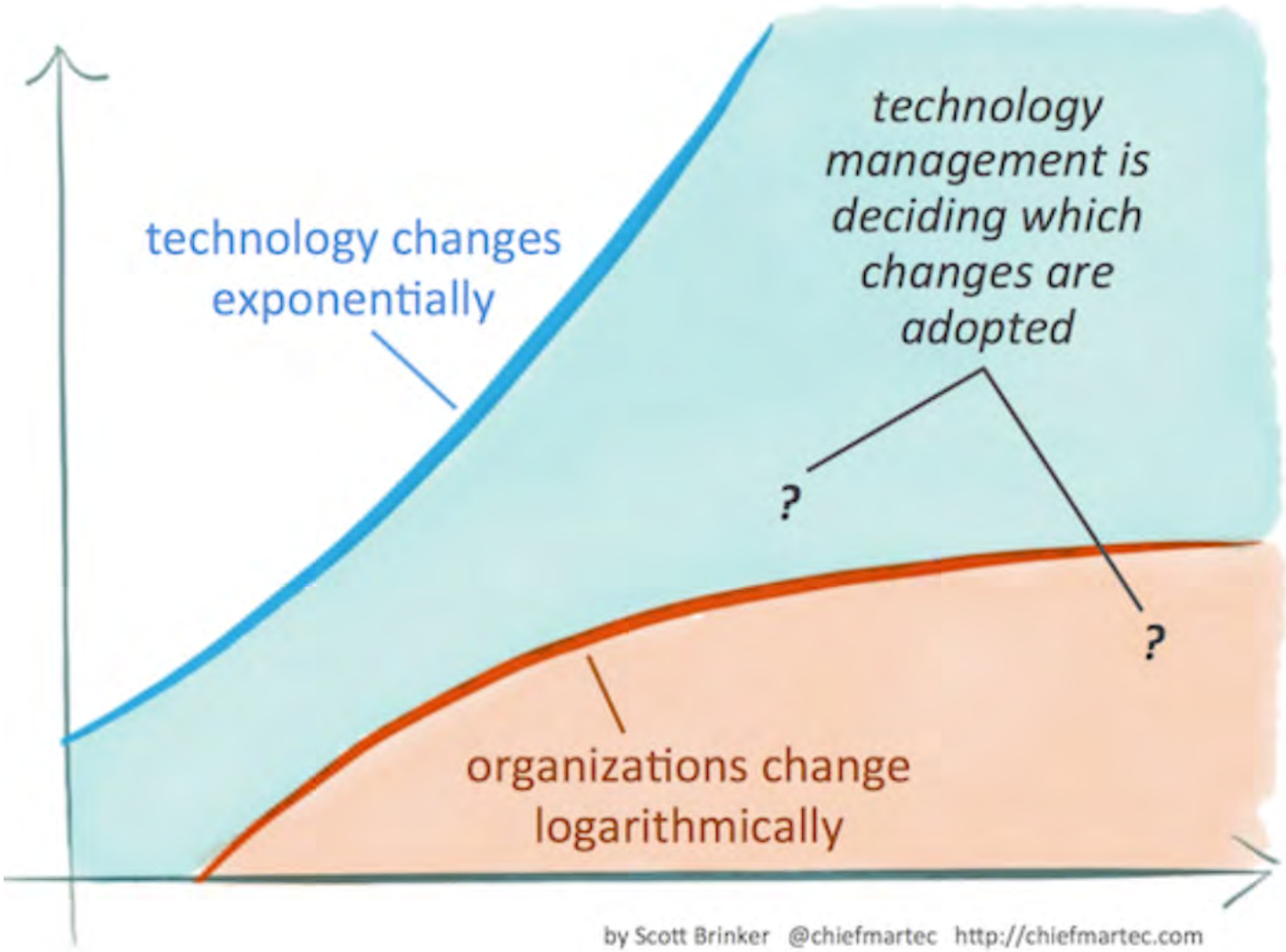
come deve essere fatto e/o **comportarsi** (**CAD + Simul.**)

a…

come può **essere usato**, come ci si può interagire e come si comporta non solo funzionalmente ma anche fisicamente (**VP**)

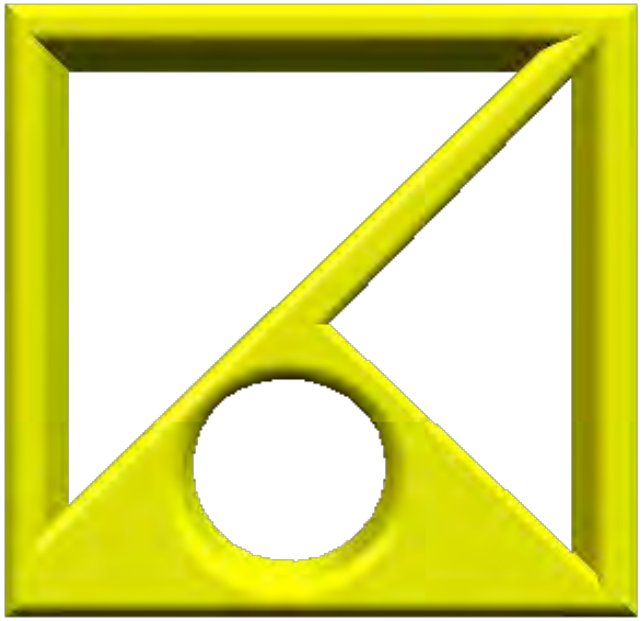
Quindi enfasi sulla **interazione da parte di molti**, ognuno dal suo punto di vista con il suo obiettivo ed il suo skill

Bisogna decidere …



…. e piuttosto rapidamente … forse!

Questions or Comments ?



KAEMaRT

Knowledge
Aided
Engineering
Manufacturing
and
Related
Technologies
Group

http://www.kaemart.it