

Non-linear thinking for Puzzled CBIsters

October 25th, 2019 Markus Nordberg (CERN)

Here at CERN we are for not solving
incremental challenges
...but what does it really mean?

Talk to Pablo, folks. These slides are by him!

Why would you be interested in “exponential”?

Because you maybe interested in “sustainability”



Let's briefly explore together.

Second story: What is the cheapest way to get to the Moon?



What is the cheapest way to get to the Moon?



1. Take a piece of paper.

2. Start folding it in half each time.

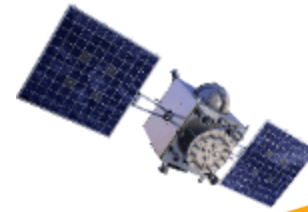
What is the cheapest way to get to the Moon?

45 folds ~ Congratulations,
you have reached the Moon!

40 folds
~ GPS satellite orbit

30 folds
~ Altitude of planes

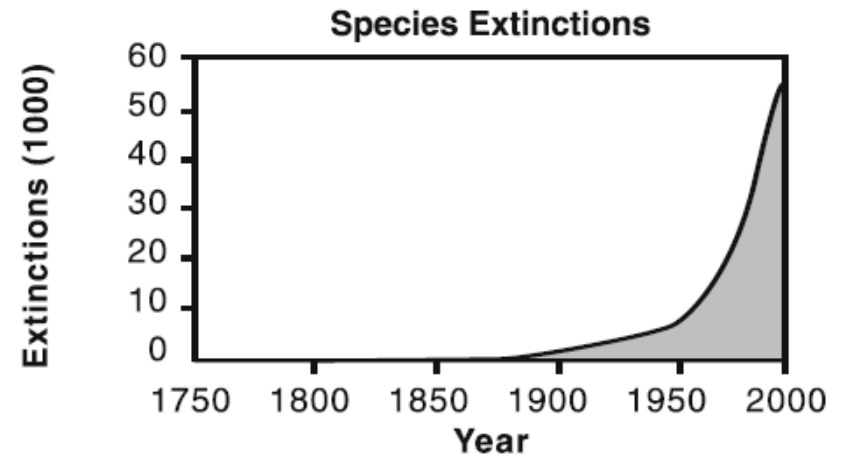
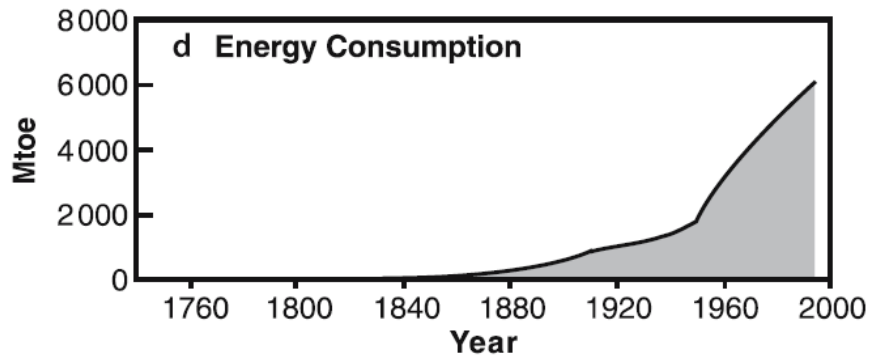
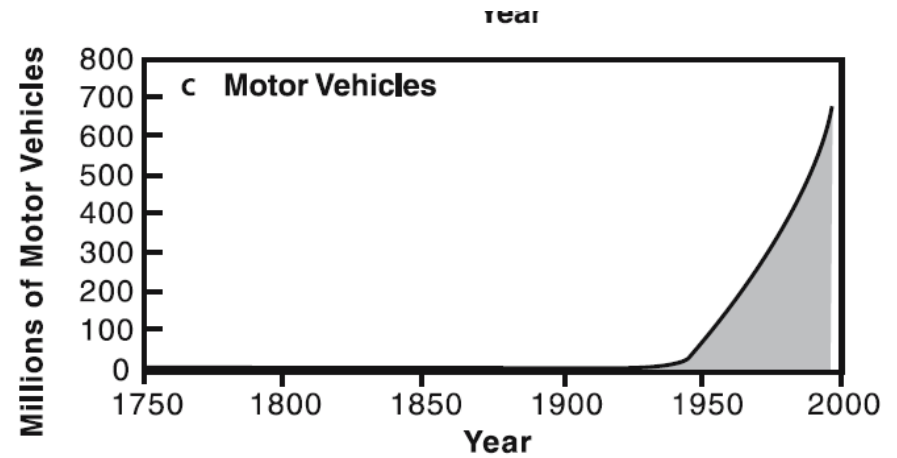
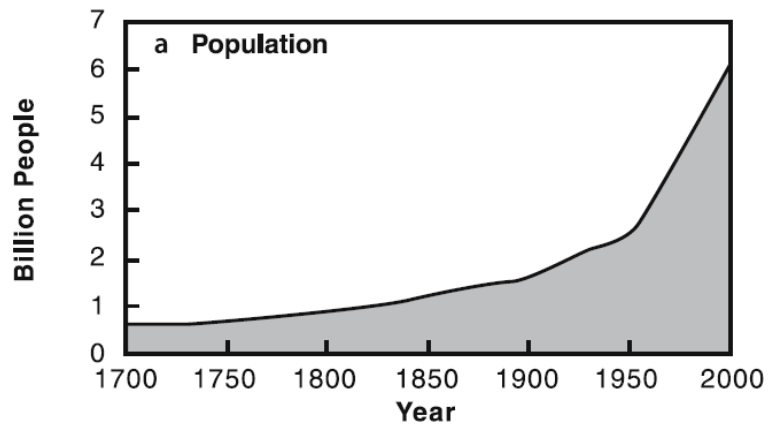
25 folds
~ Empire State Building



Folding increases thickness
exponentially

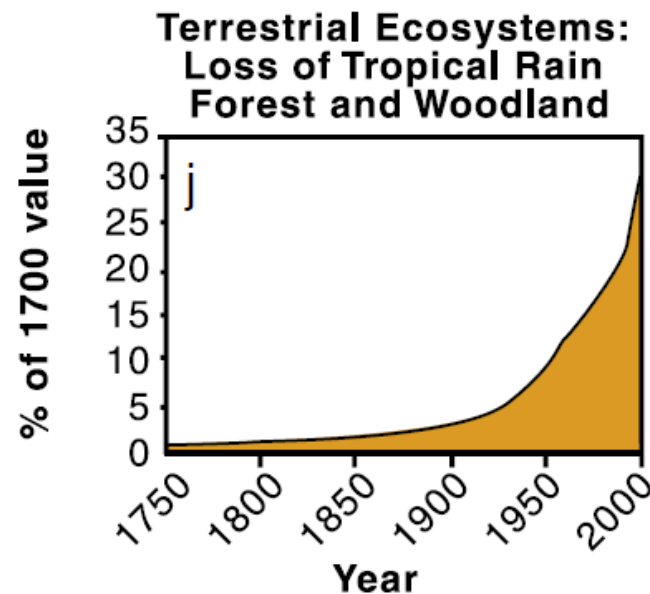
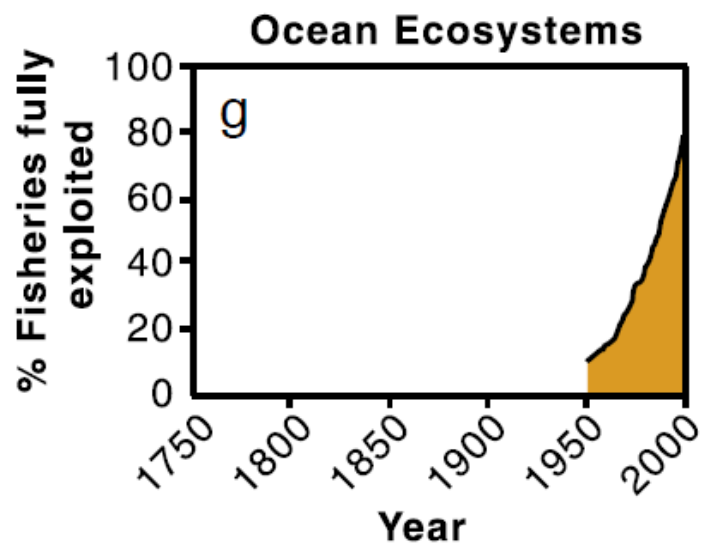
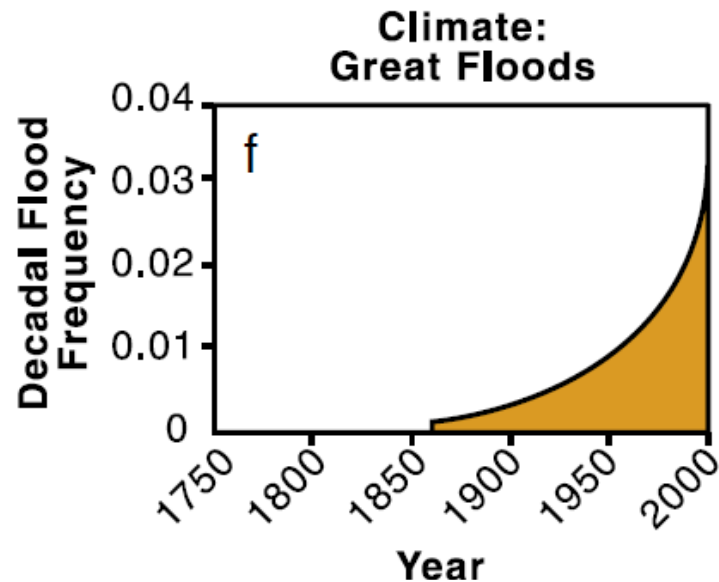
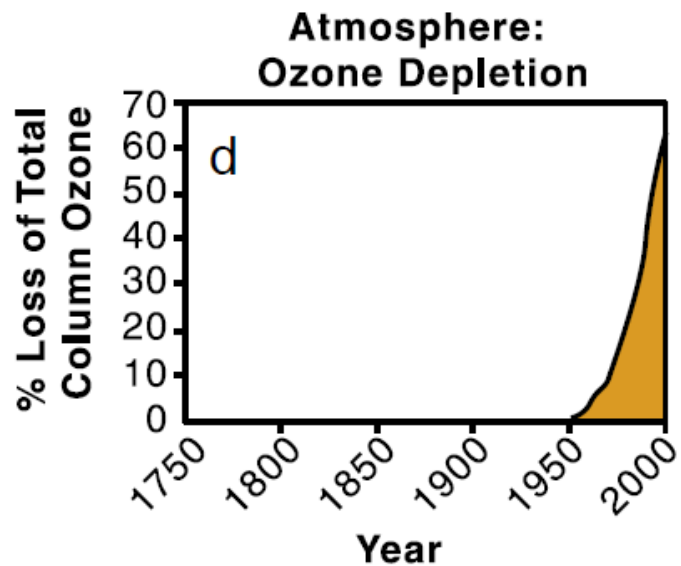
How does exponential growth looks like?





Source:

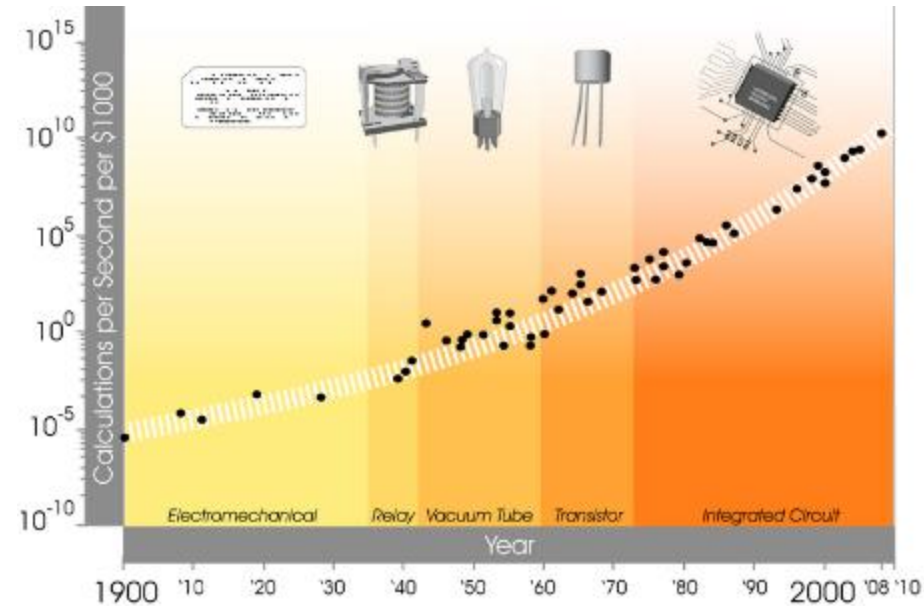
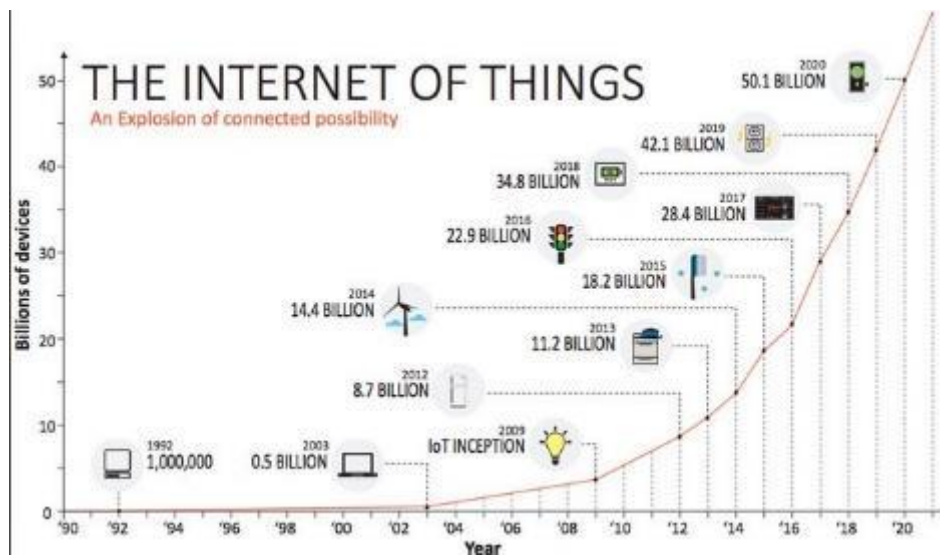
“Global Change and the Earth System: A Planet Under Pressure” (2004), W. Steffen, et al., Springer-Verlag Berlin Heidelberg New York.



Source:

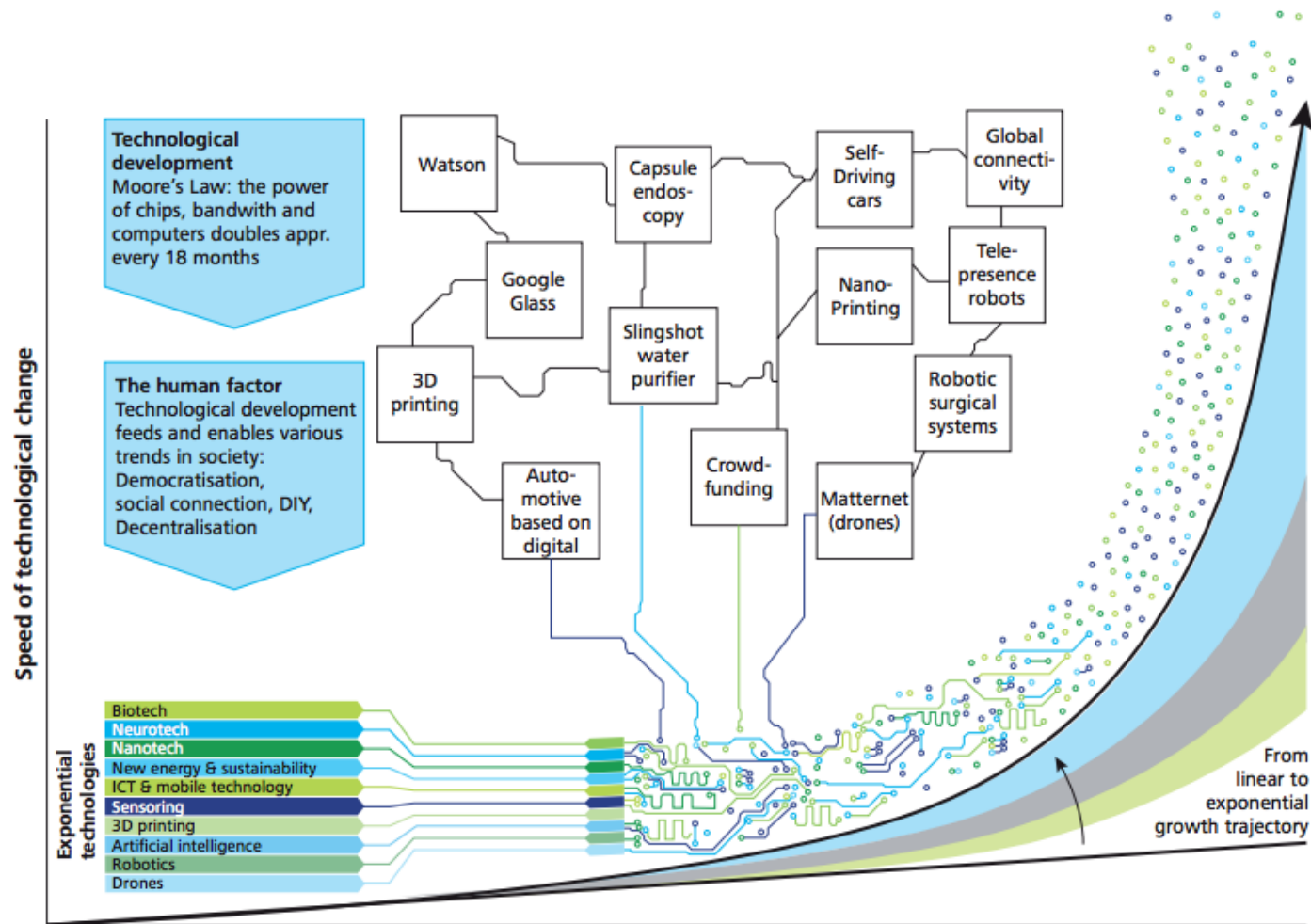
“Global Change and the Earth System: A Planet Under Pressure” (2004), W. Steffen, et al., Springer-Verlag Berlin Heidelberg New York.

Technology seems to grow exponentially...



Internet of Things: online guide to the Internet of Things, <http://www.i-scoop.eu/internet-of-things/> and <https://exponential.singularityu.org/>

As well as the way several technologies are converging, adopted and the possibilities they may bring...

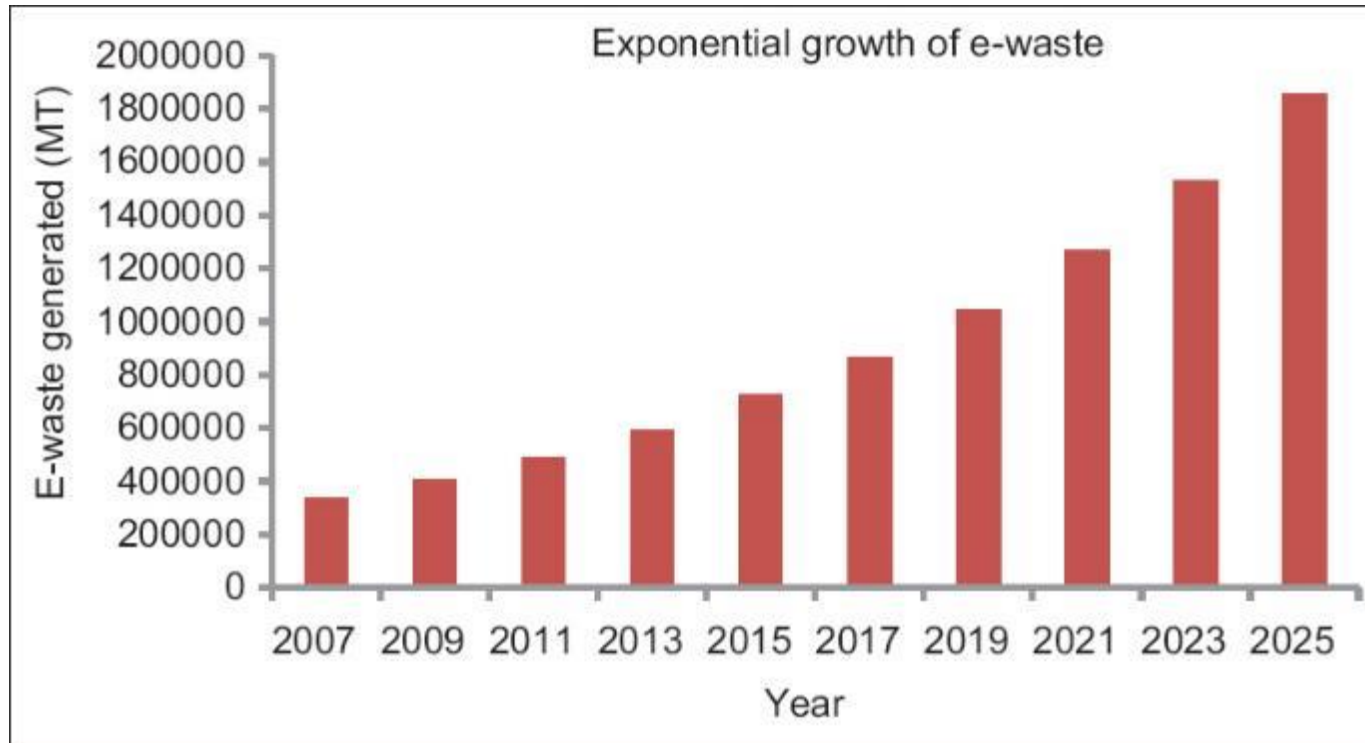


Source: Deloitte 4.0 report 2015

<https://www2.deloitte.com/content/dam/Deloitte/ch/Documents/manufacturing/ch-en-manufacturing-industry-4-0-24102014.pdf>

Pablo Garcia Tello, CERN, IdeaSquare

...but this doesn't come for free...

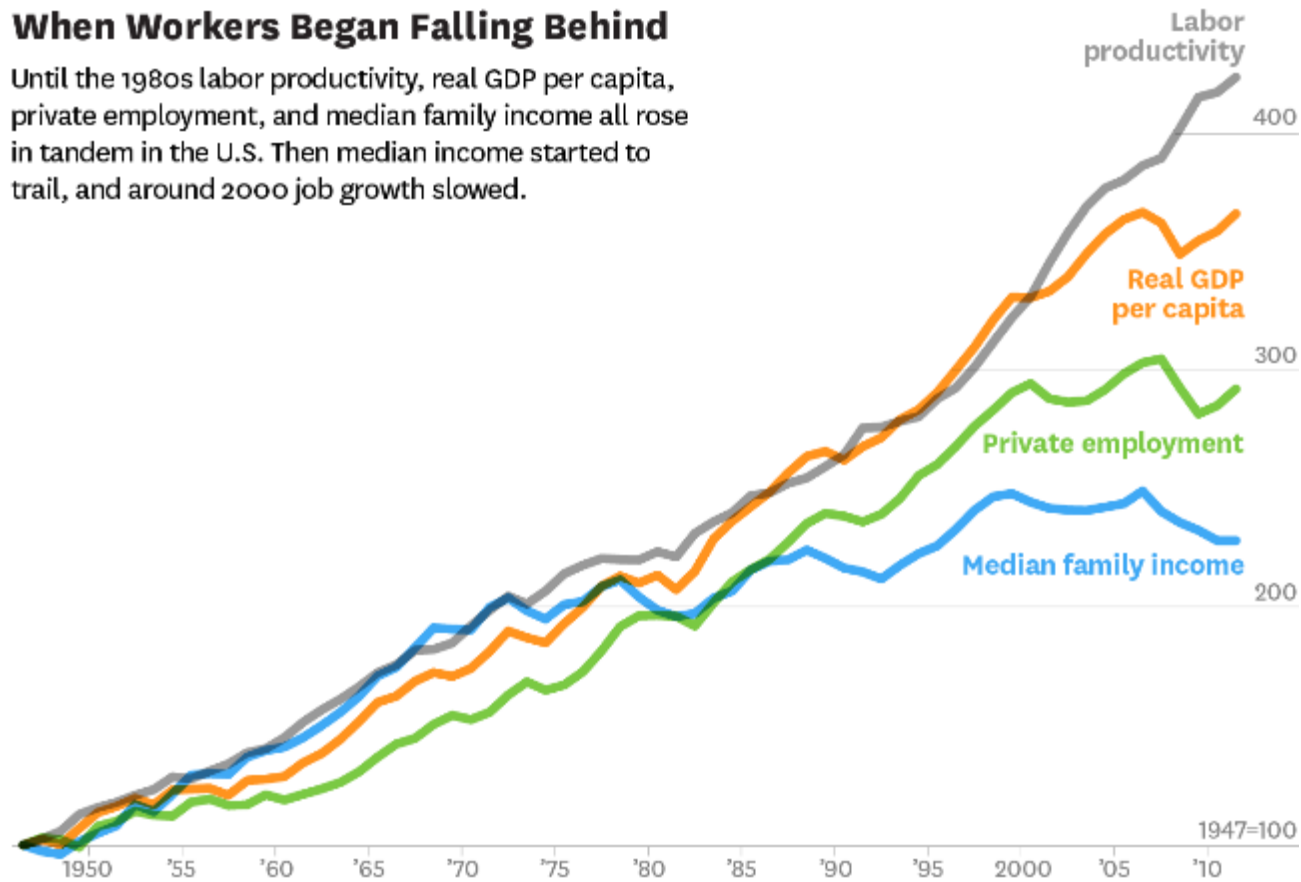


(India figures)

J. Annamalai, *Occupational health hazards related to informal recycling of E-waste in India: An overview*, *Indian Journal of Occupational and Environmental Medicine*, Vol. 19, No. 1, January-April, 2015, pp. 61-65.

When Workers Began Falling Behind

Until the 1980s labor productivity, real GDP per capita, private employment, and median family income all rose in tandem in the U.S. Then median income started to trail, and around 2000 job growth slowed.



SOURCE: FEDERAL RESERVE BANK OF ST. LOUIS; ERIK BRYNJOLFSSON AND ANDREW MCAFEE
FROM "THE GREAT DECOUPLING," JUNE 2015

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Quite some wise voices are starting to talk about “The Great Decoupling”: productivity is rising, but employment may not.

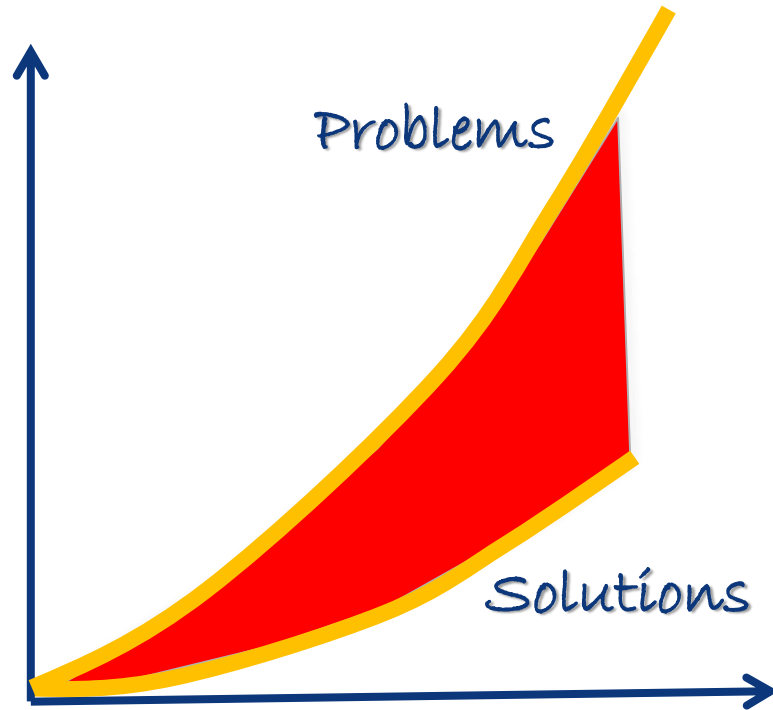
The rule of 70

Quick math trick

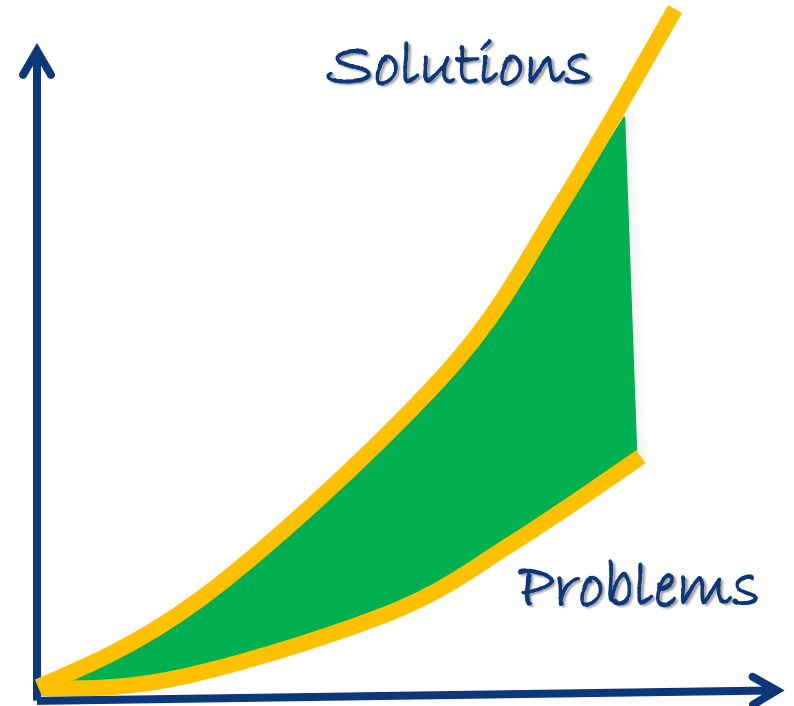
$$\text{Doubling time} = \frac{70}{\% \text{ growth rate}}$$

For example, if somebody tells you that unemployment in your region has 2% annual growth it will double in just 35 years.

Conclusion: We hope humankind will follow the right law...



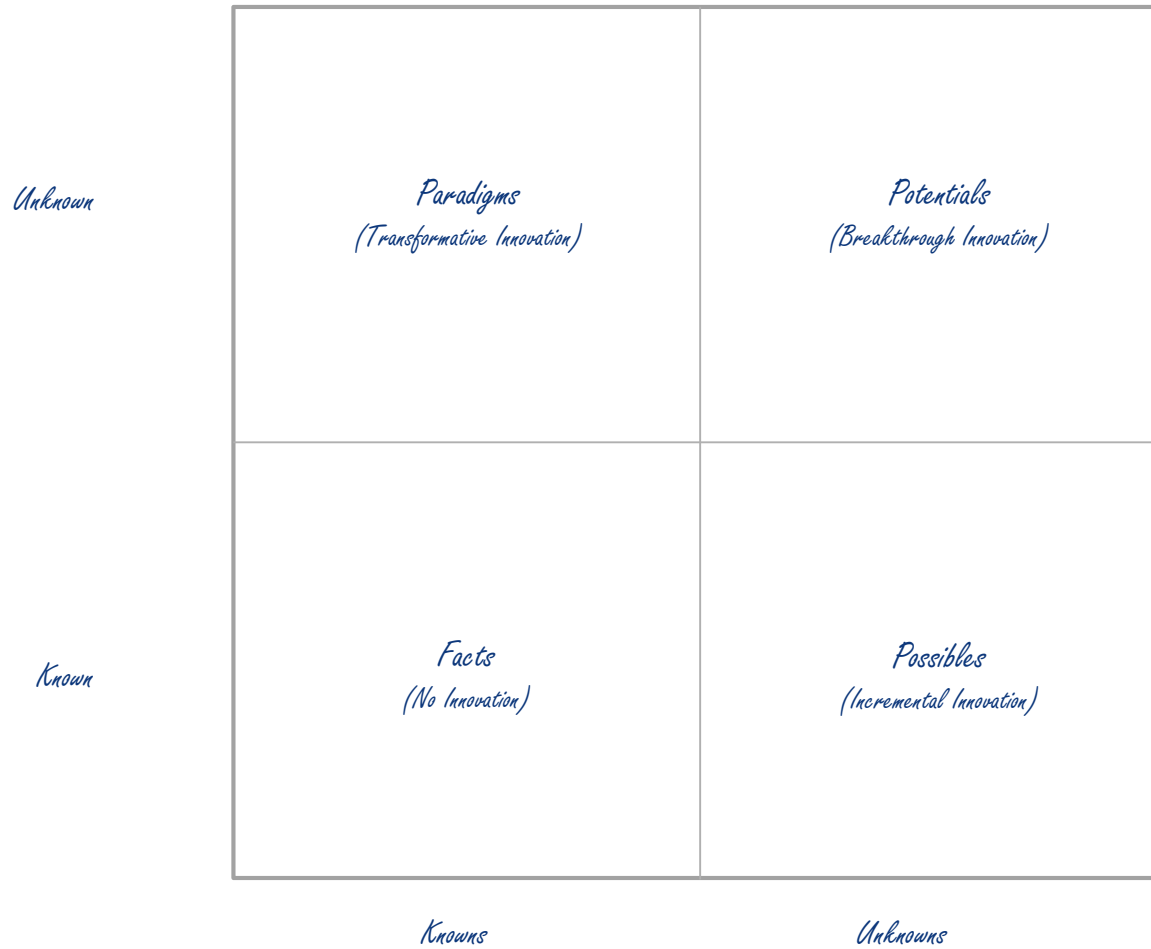
Law of increasing ignorance



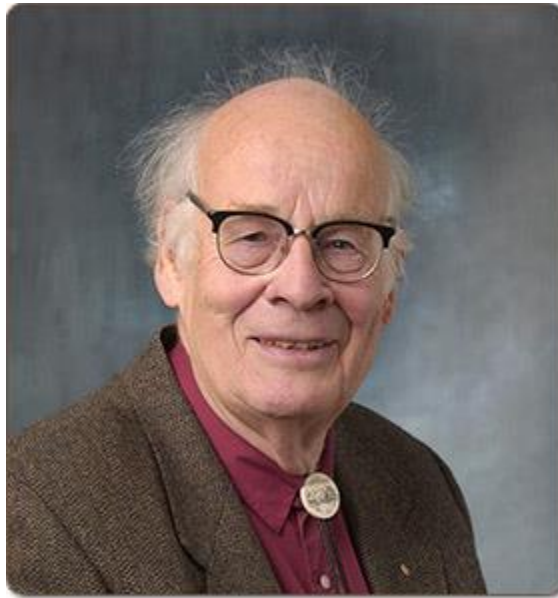
Law of increasing wisdom

But it is just hope...after all, we are just physicists working at CERN...

Transformation wanted!



Thanks for your attention questions...



*The greatest shortcoming of the human race is our inability
to understand the exponential function.*

Albert A. Bartlett (1923-2013), Physicist