esade

ATC
ASOCIACIÓN ESPAÑOLA
TÉCNICOS CERÁMICOS

# La Nueva Globalización

## Innovación y Competitividad en un Mundo Fragmentado

Xavier Ferràs, MBA, PhD

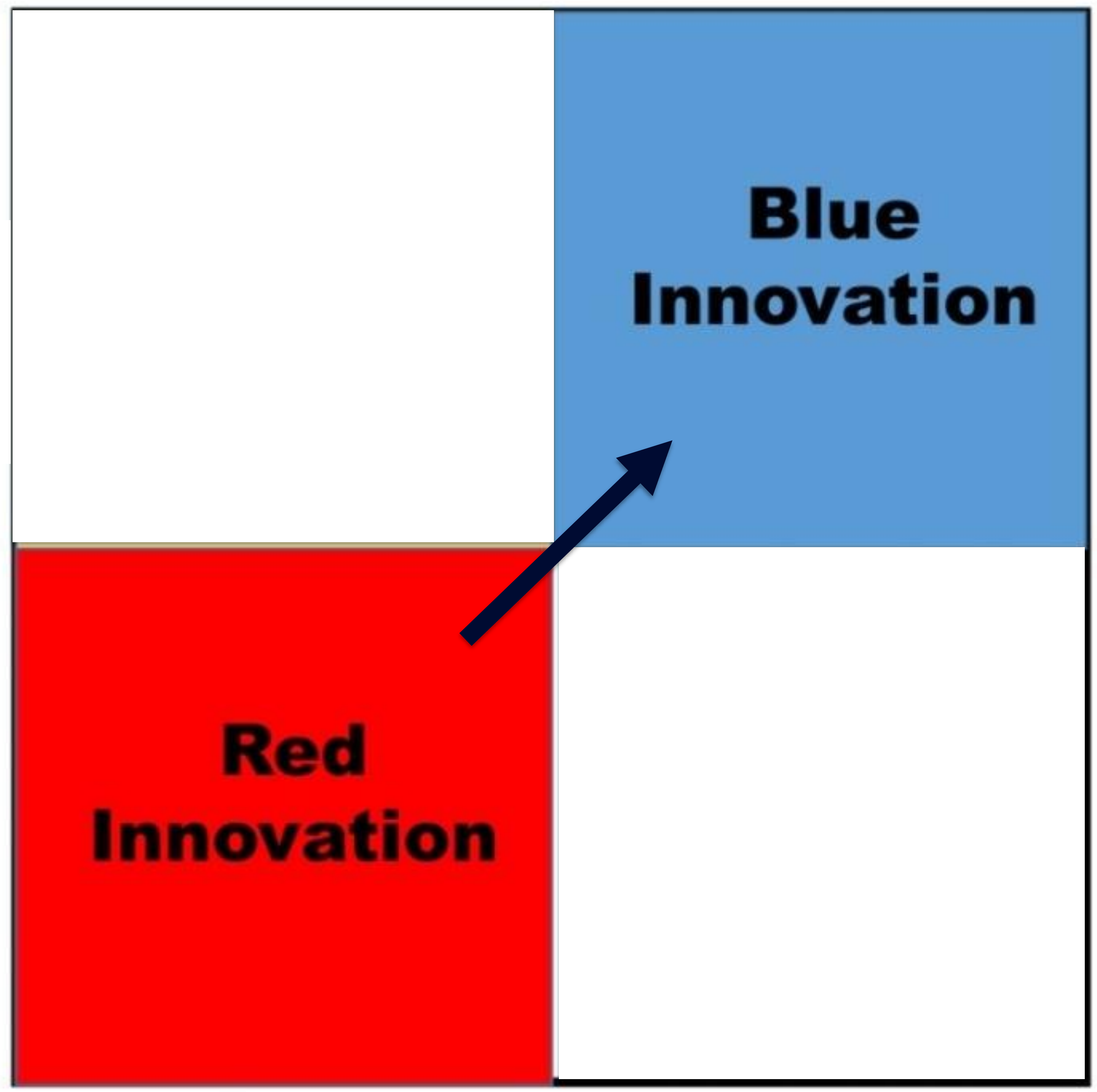
ATC- Castellón-04/11/21

Do Good. Do Better.

# ¿Qué es la “Innovación”?

High Economic Reward

Low Economic Reward




Low Risk High Risk

**Strategic Choice: Competing in price or in value**? (M.Porter)

**<u>All RATIONAL decisions are made in red or in blue.</u>**
**<u>Both are rational</u>**

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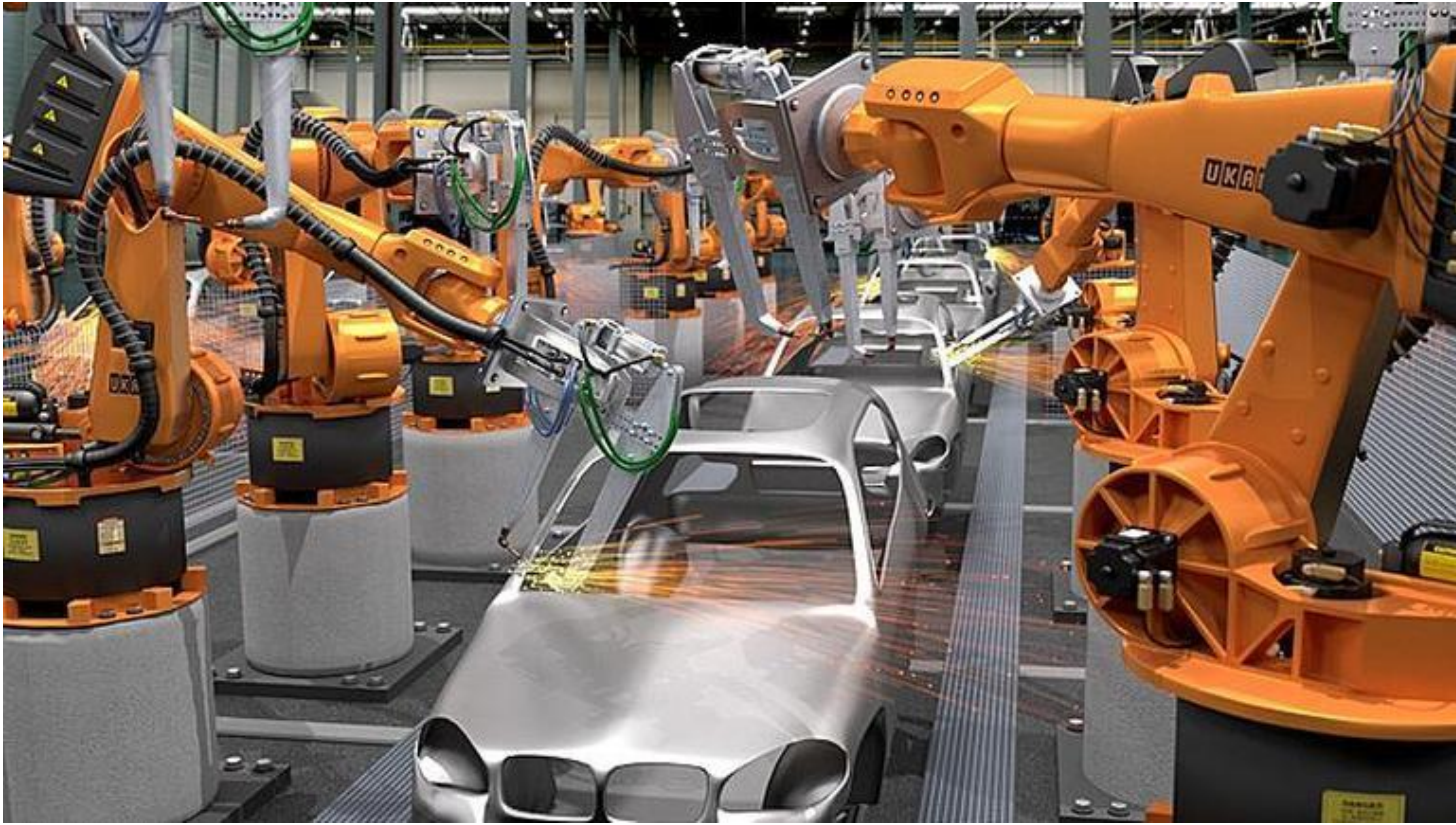
# ¿Innovación o mejora?

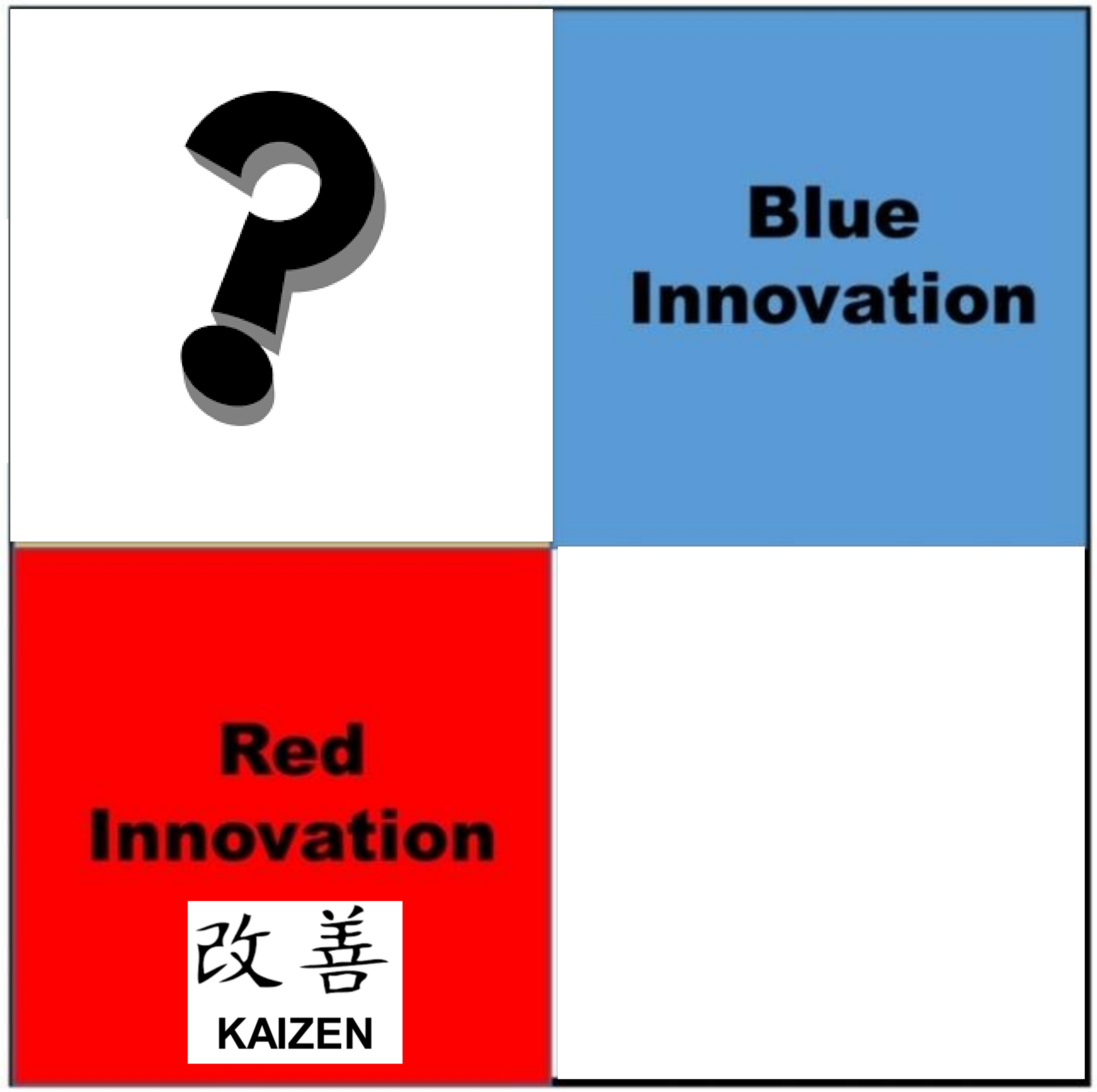



**¿Qué pasa si no lo hago?**

# Improvement is an executive imperative
# Innovation is a strategic option

High
Economic
Reward

Low
Economic
Reward




Low Risk

High Risk

**Strategic Choice: Competing in price or in value**?
(M.Porter)

KAIZEN = “CONTINUOUS IMPROVEMENT”
TQM = TOTAL QUALITY MANAGEMENT TECHNIQUES

High Economic Reward

**Gold Innovation**

**Blue Innovation**

Low Economic Reward

**Red Innovation**

改善
KAIZEN

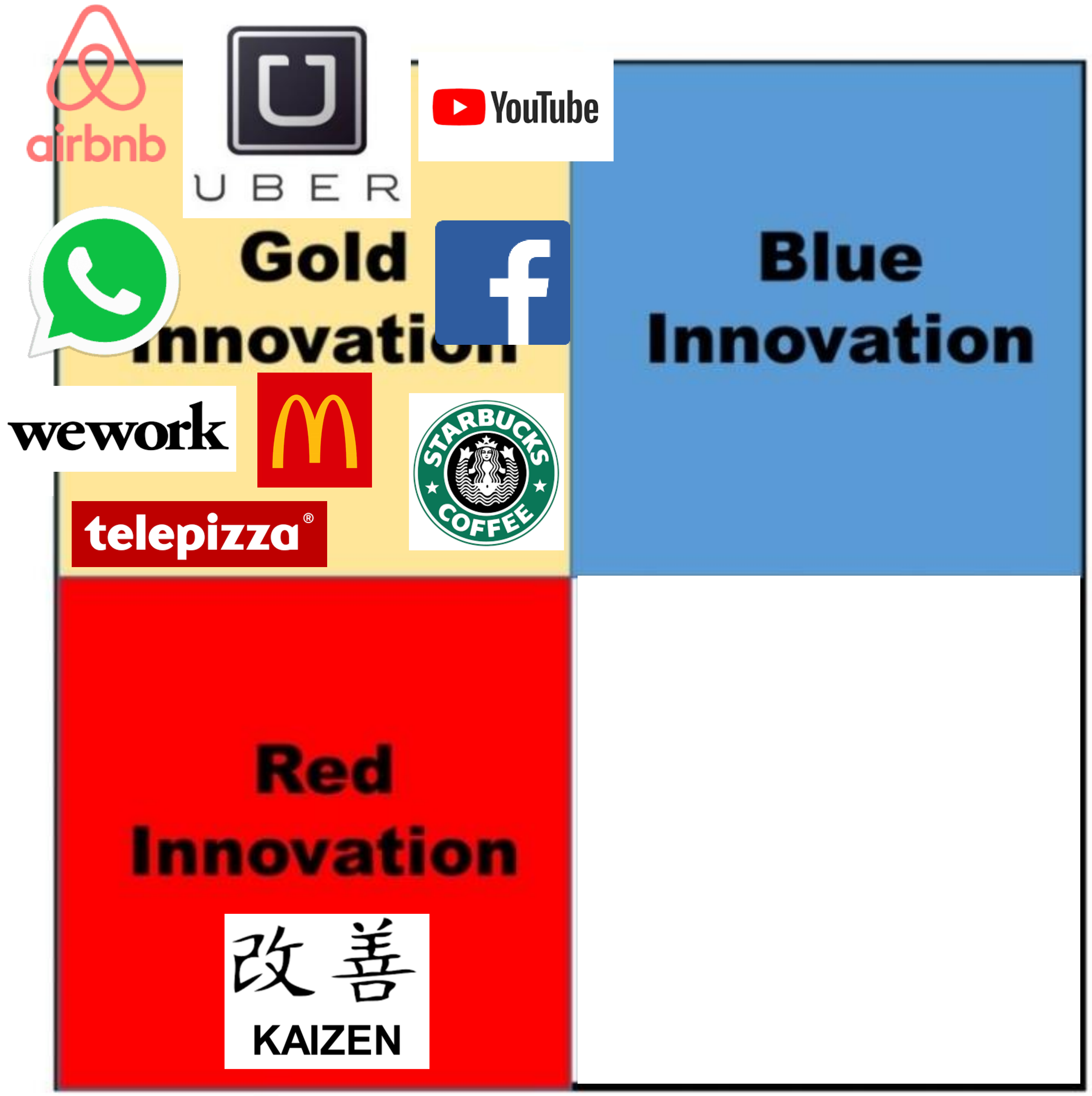
Low Risk

High Risk

**Scalable business models**

High Economic Reward

Low Economic Reward



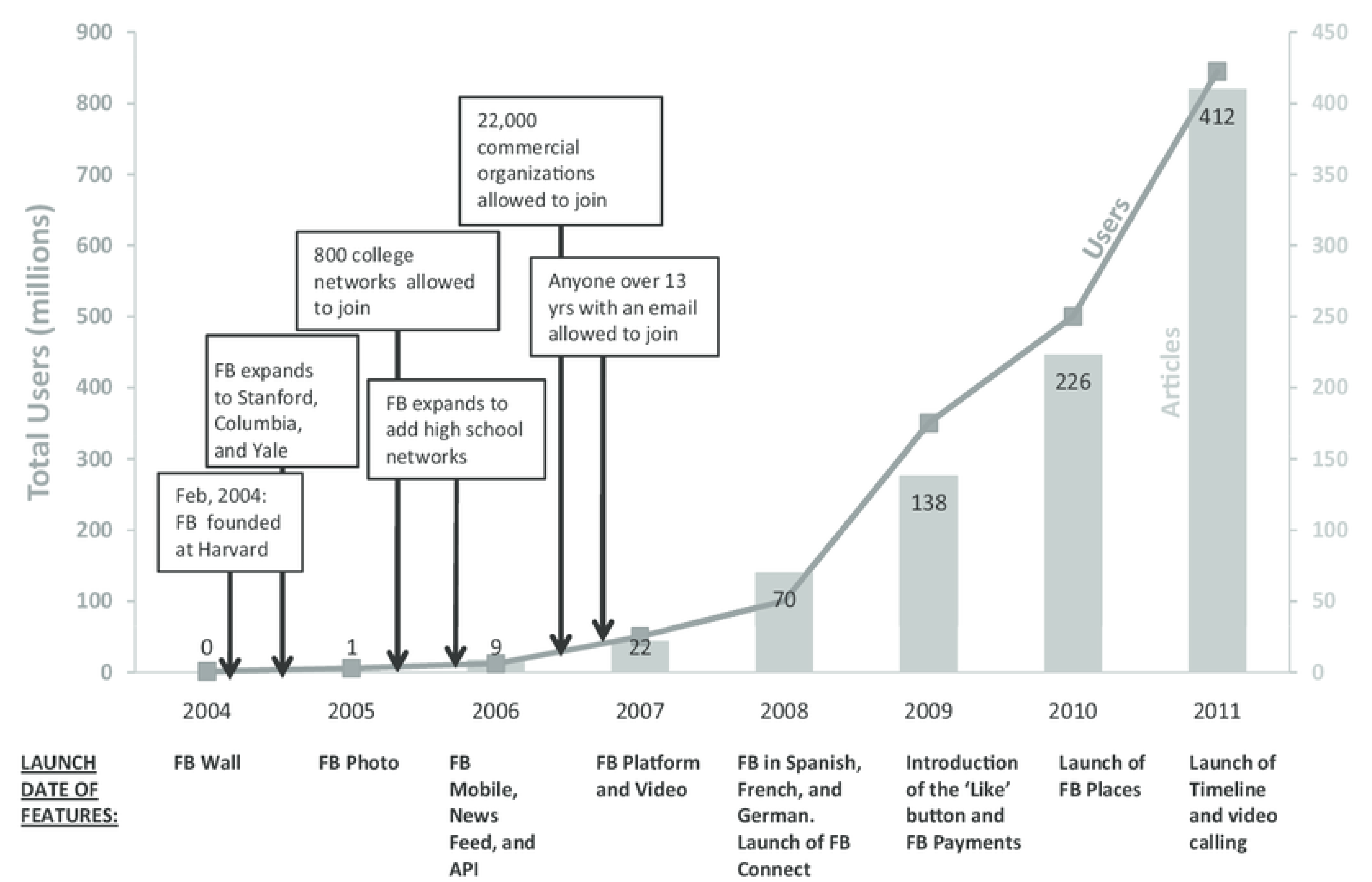

Low Risk

High Risk

# Desmitificando algunas cosas…

*“The site was created entirely by Zuckerberg over the last week in October, after a friend gave him the idea. The website used photos compiled from the online facebooks, placing two next to each other at a time and **asking users to choose the “hotter” person**”*

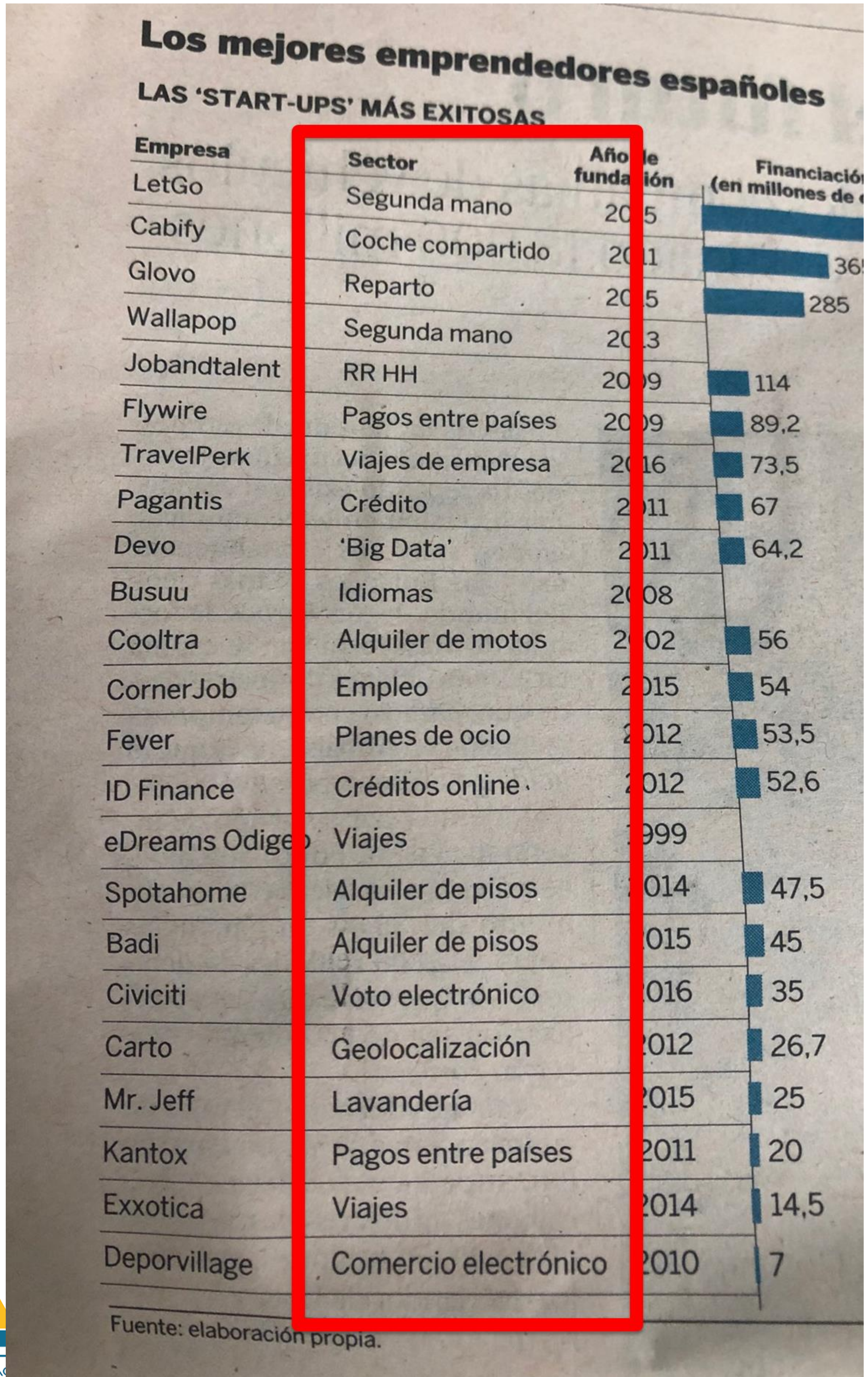
The Harvard Crimson, 2003


S. Gosling, “A Review of Facebook Research in the Social Sciences”

ASOCIACIÓN E TÉCNICOS CEI

# Gold Mines –Risk of "Gig Economy"?



## Los mejores emprendedores españoles

LAS 'START-UPS' MÁS EXITOSAS

| Empresa | Sector | Año de fundación | Financiación (en millones de |
|---|---|---|---|
| LetGo | Segunda mano | 20 5 | |
| Cabify | Coche compartido | 20 1 | 36 |
| Glovo | Reparto | 20 5 | 285 |
| Wallapop | Segunda mano | 20 3 | |
| Jobandtalent | RR HH | 20 9 | 114 |
| Flywire | Pagos entre países | 20 9 | 89,2 |
| TravelPerk | Viajes de empresa | 2 16 | 73,5 |
| Pagantis | Crédito | 2 11 | 67 |
| Devo | 'Big Data' | 2 11 | 64,2 |
| Busuu | Idiomas | 2 08 | |
| Cooltra | Alquiler de motos | 2 02 | 56 |
| CornerJob | Empleo | 015 | 54 |
| Fever | Planes de ocio | 012 | 53,5 |
| ID Finance | Créditos online | 012 | 52,6 |
| eDreams Odige | Viajes | 999 | |
| Spotahome | Alquiler de pisos | 014 | 47,5 |
| Badi | Alquiler de pisos | 015 | 45 |
| Civiciti | Voto electrónico | 016 | 35 |
| Carto | Geolocalización | 012 | 26,7 |
| Mr. Jeff | Lavandería | 015 | 25 |
| Kantox | Pagos entre países | 2011 | 20 |
| Exxotica | Viajes | 2014 | 14,5 |
| Deporvillage | Comercio electrónico | 2010 | 7 |

Fuente: elaboración propia.

# Spain's Glovo picks up $528M as Europe's food delivery market continues to heat up

**Ingrid Lunden** @ingridlunden / 8:01 AM GMT+2 • April 1, 2021 Comment


TECH TRANSPORTATION UBER

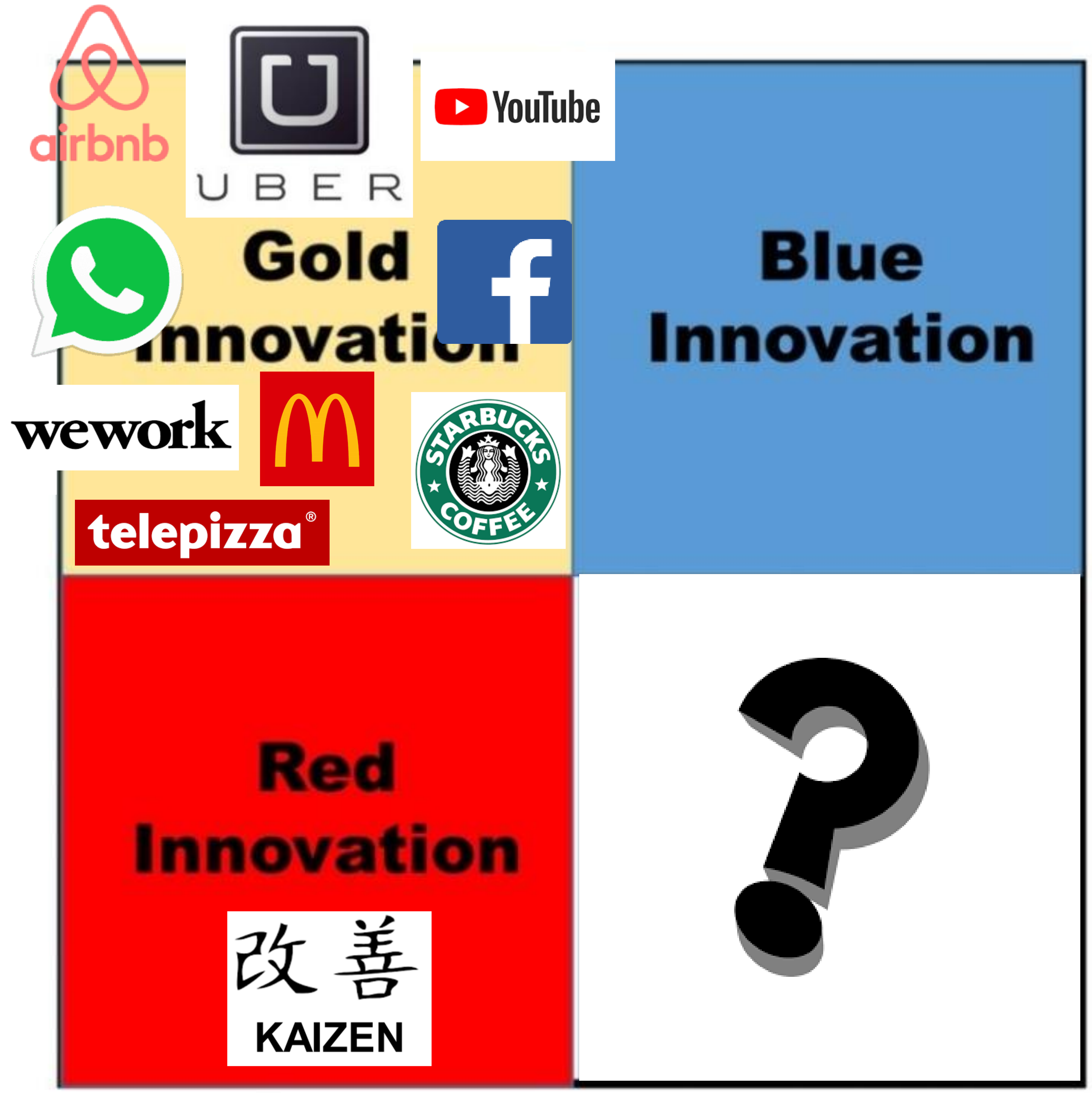
## Uber lost $8.5 billion in 2019, but it thinks it can get profitable by the end of 2020

*Q4 losses were pretty much the same as the previous quarter*

## The WeWork fiasco of 2019, explained in 30 seconds

**Rebecca Aydin** Oct 22, 2019, 5:12 PM

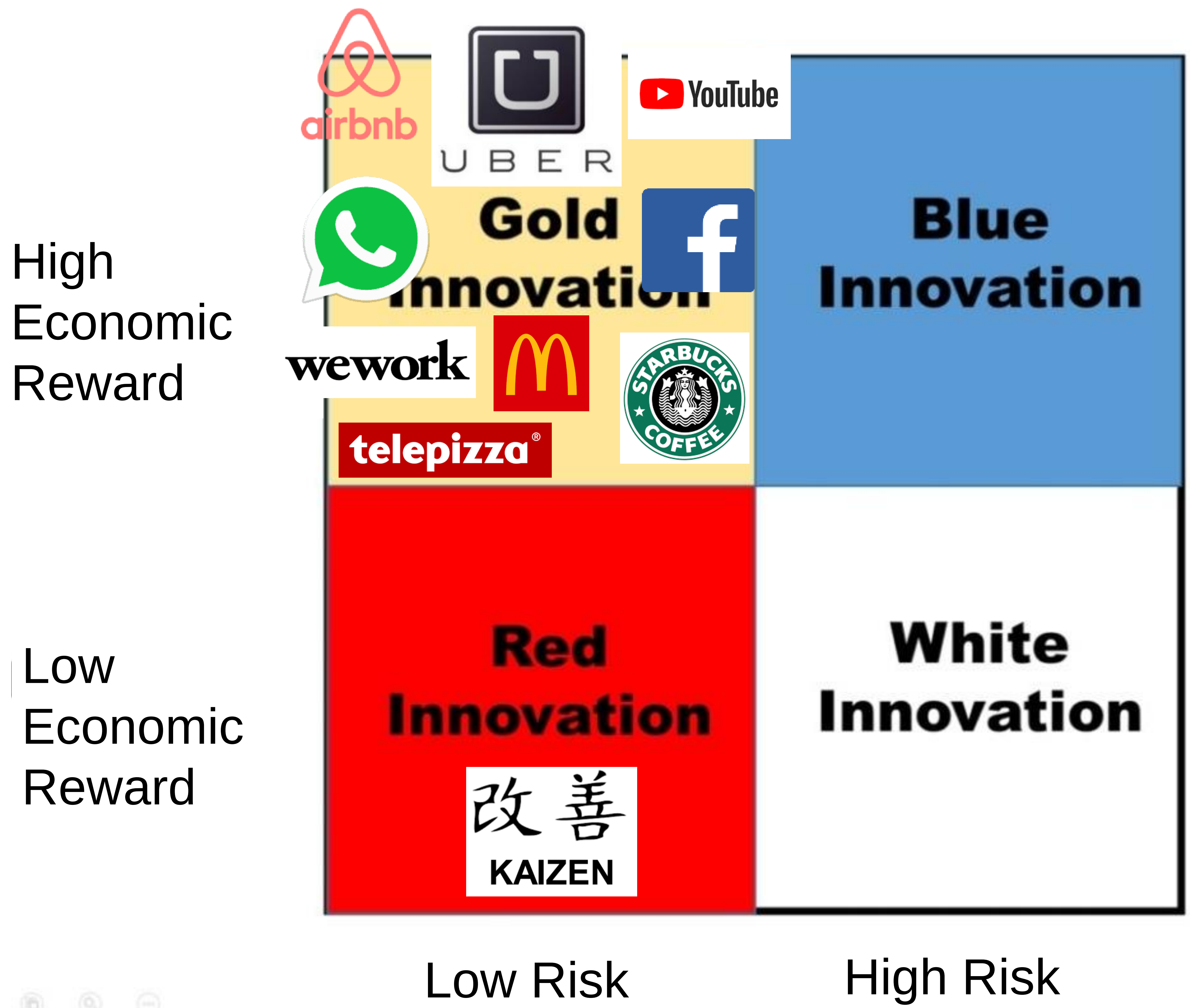
High
Economic
Reward

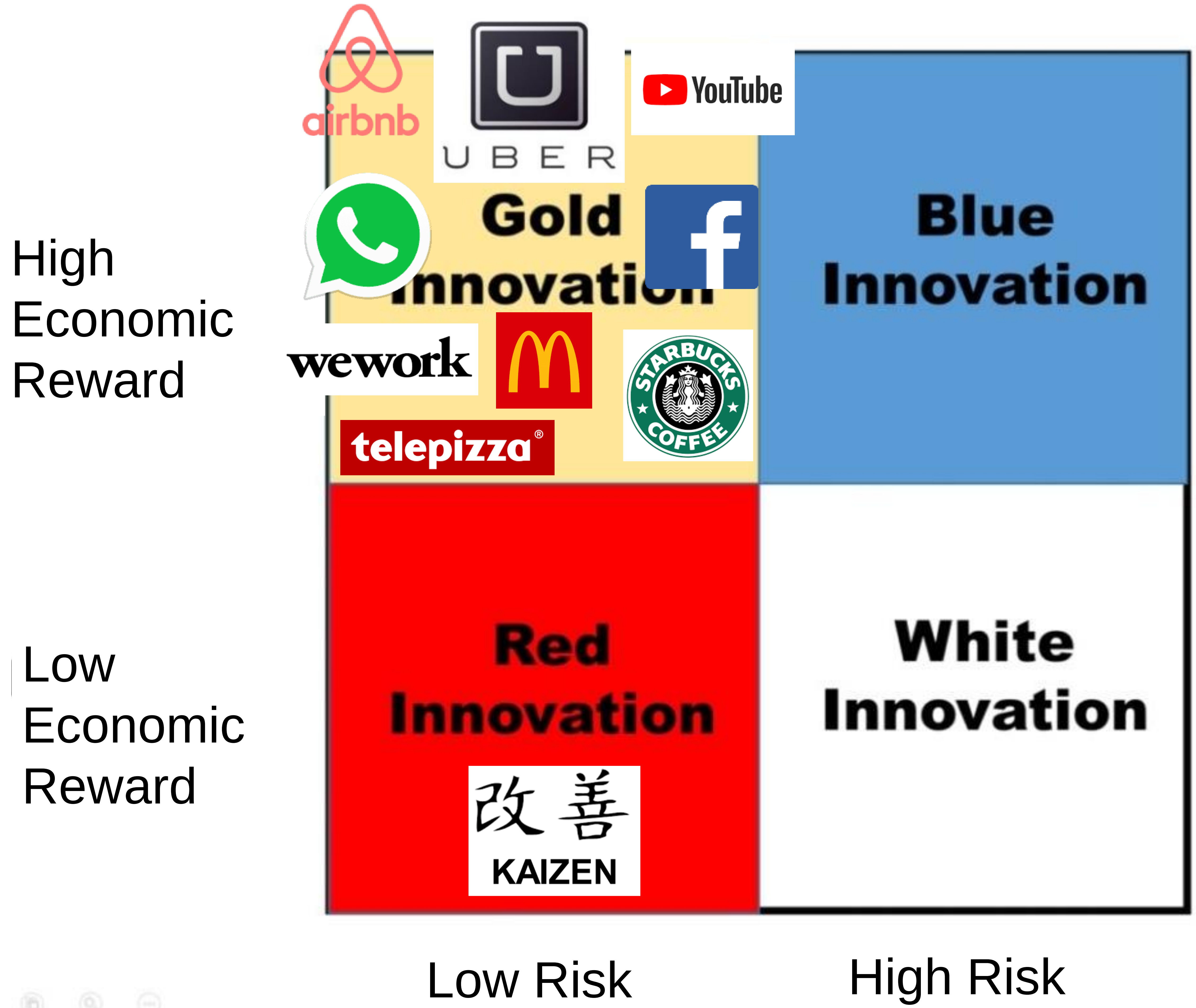



Low
Economic
Reward

Low Risk

High Risk


airbnb
UBER
YouTube
Gold Innovation
Blue Innovation
wework
telepizza
STARBUCKS COFFEE
High Economic Reward
Low Economic Reward
Red Innovation
改 善
KAIZEN
White Innovation
Low Risk
High Risk


High Economic Reward
Low Economic Reward
Gold Innovation
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airbnb
UBER
YouTube
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telepizza
STARBUCKS COFFEE
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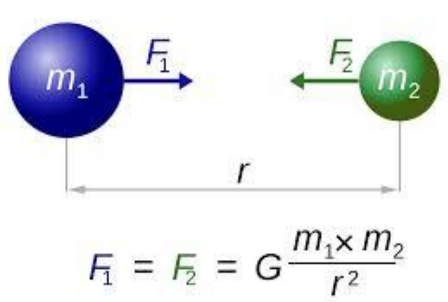
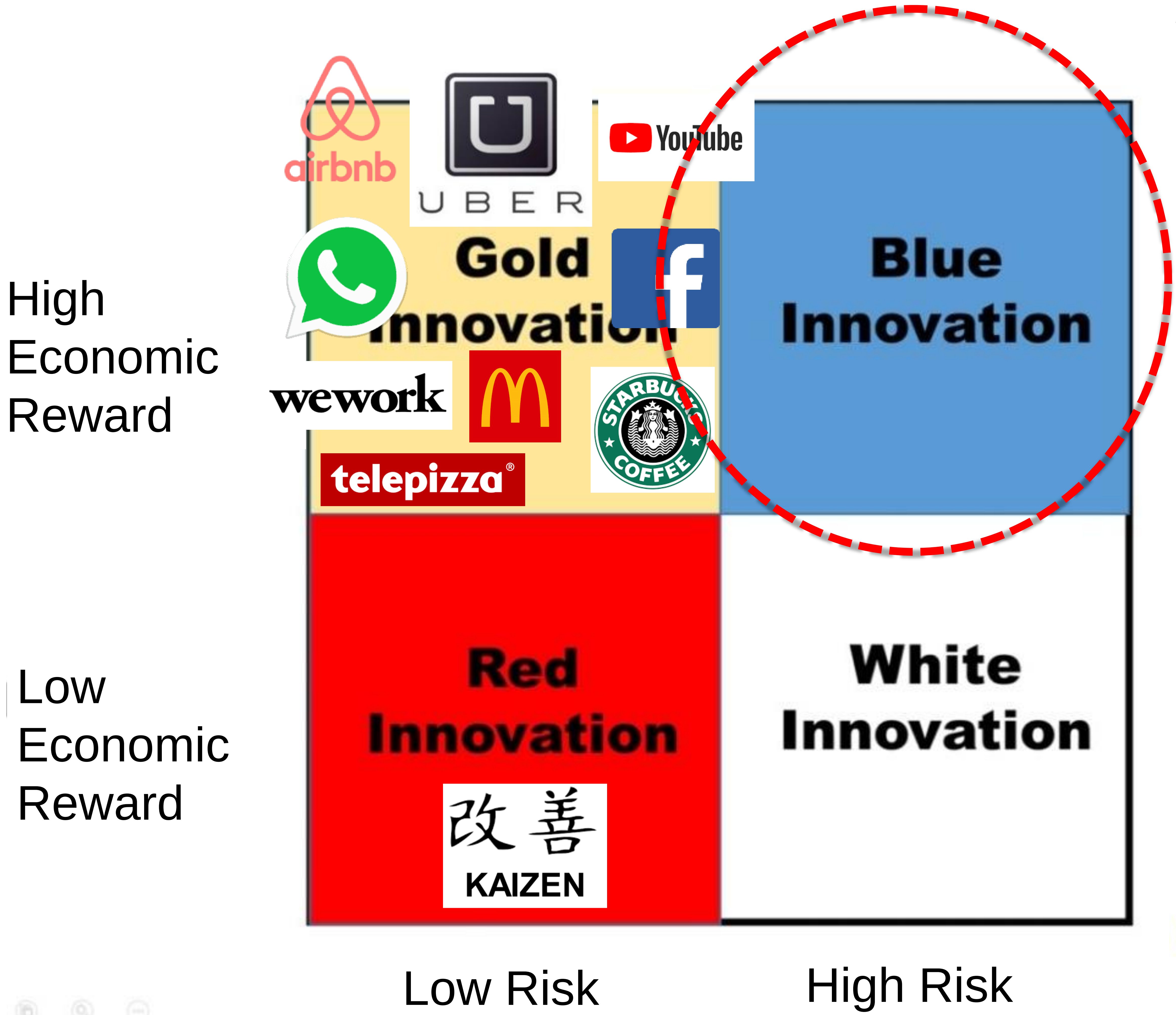
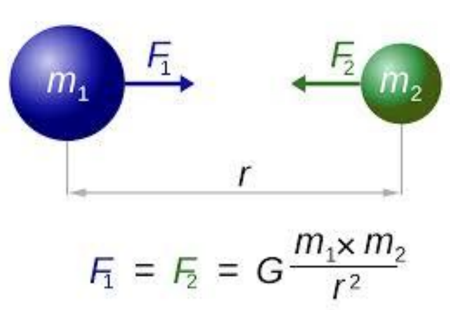
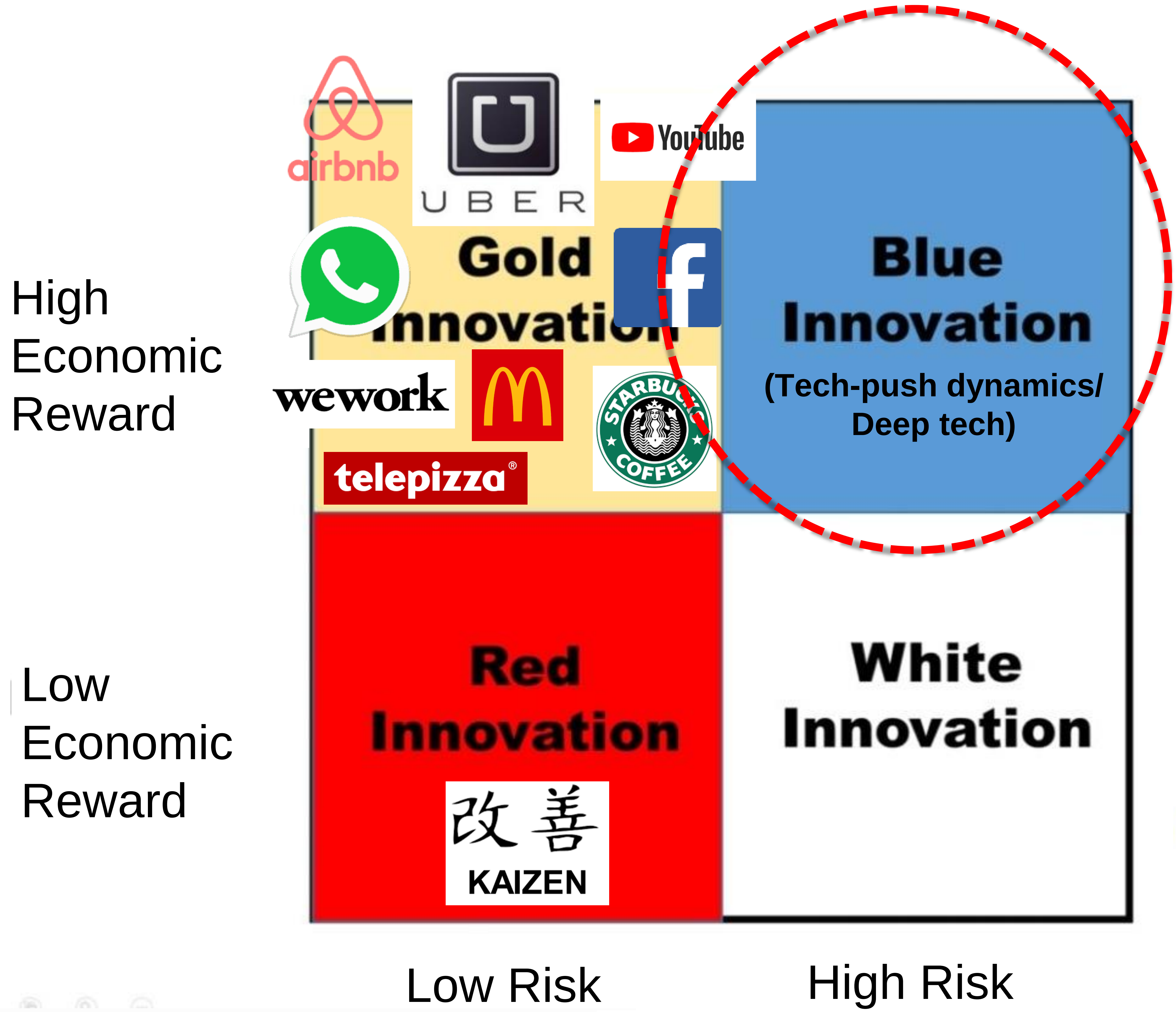

$m_1$
$F_1$
$F_2$
$m_2$
$r$
$F_1 = F_2 = G\frac{m_1 \times m_2}{r^2}$




**WHERE NEW INDUSTRIES ARISE**

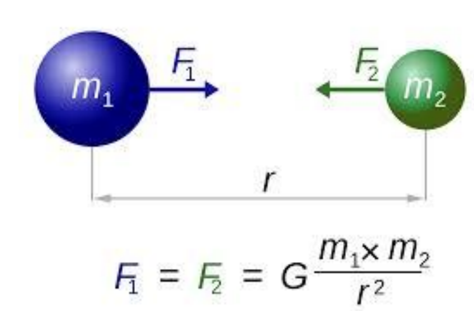
- **Car (1890)**
- **Airplane (1901)**
- **Radar (1930)**
- **Sonar (1950)**
- **Computer (1950)**
- **PC (1976)**
- **Internet (1995)**
- **Smartphone (2007)**
- **EV (2010)**






**KEY ENABLING TECHNOLOGIES**

- Internet of Things
- 3D Printing
- Advanced Robotics
- Artificial Intelligence
- Clean Energy
- Supercomputing
- Synthetic Biology…




Feb 25, 2019, 03:16pm EST | 12.380 views

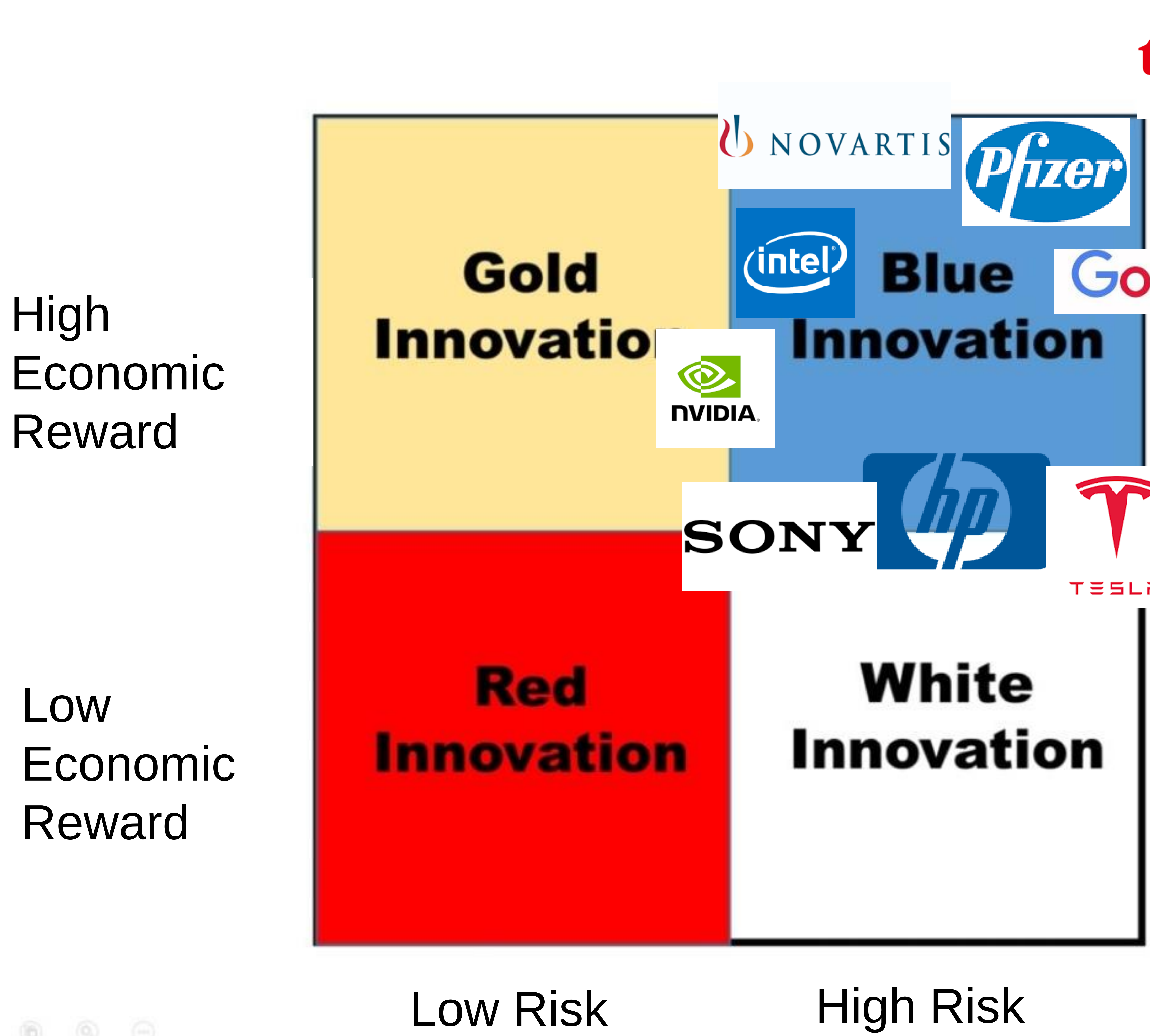
## AI Will Add $15 Trillion To The World Economy By 2030

Frank Holmes Contributor
Great Speculations Contributor Group
Markets
*CEO and CIO of U.S. Global Investors*

## Biology as technology will reinvent trillion-dollar industries

Navin Chaddha 12:00 AM GMT+2 • September 18, 2019

Comment

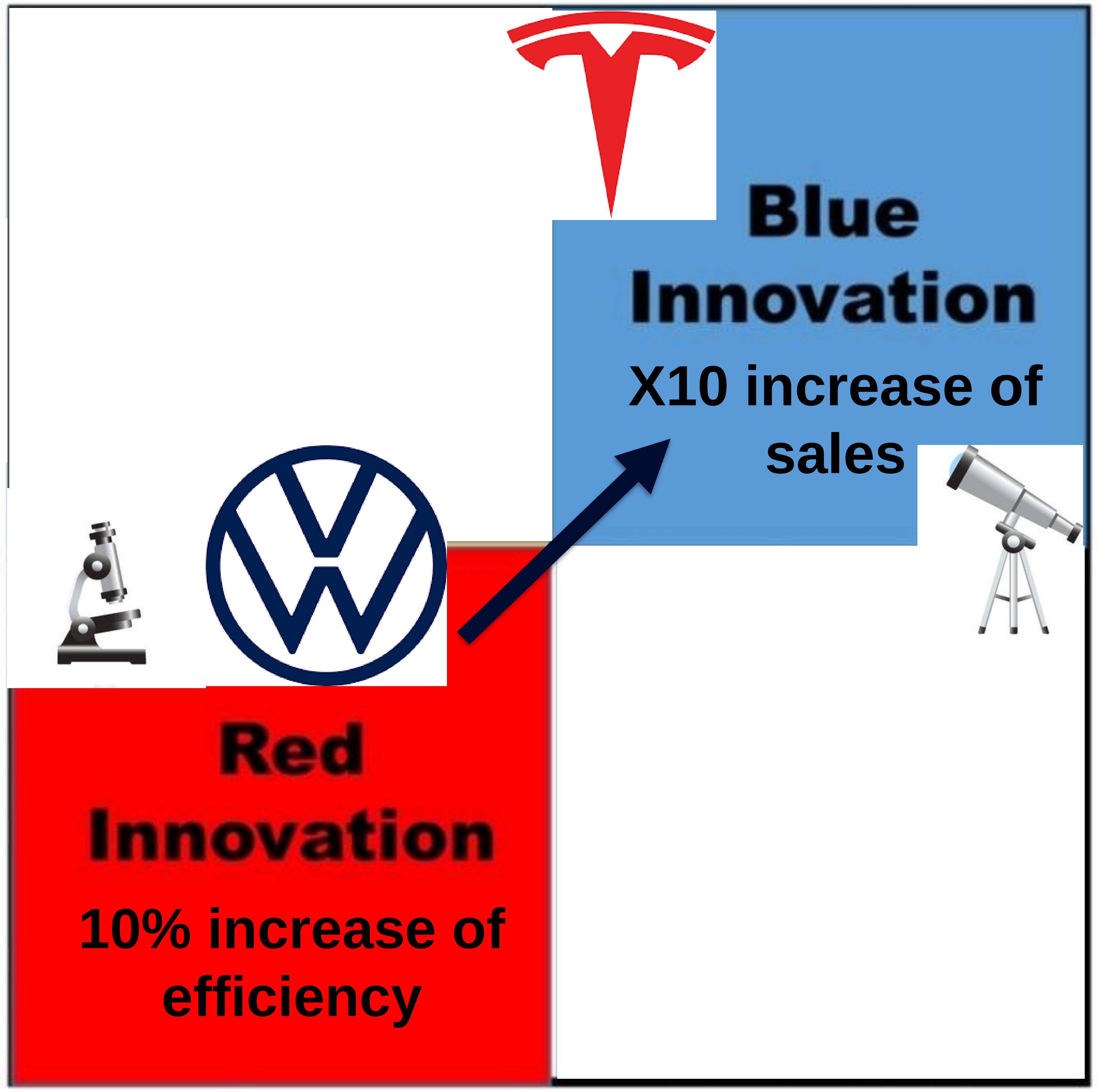



**These are the type of companies that create *innovation ecosystems* "Blue innovation" companies, that attract talent and create prosperity**

# Ambidexterity: Explotar y Explorar

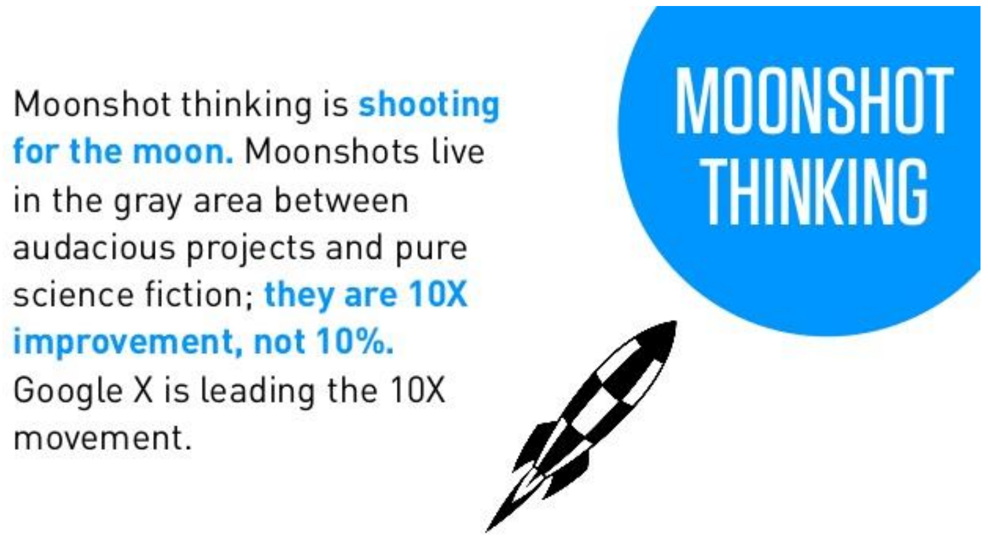
High Economic Reward

Low Economic Reward




Low Risk

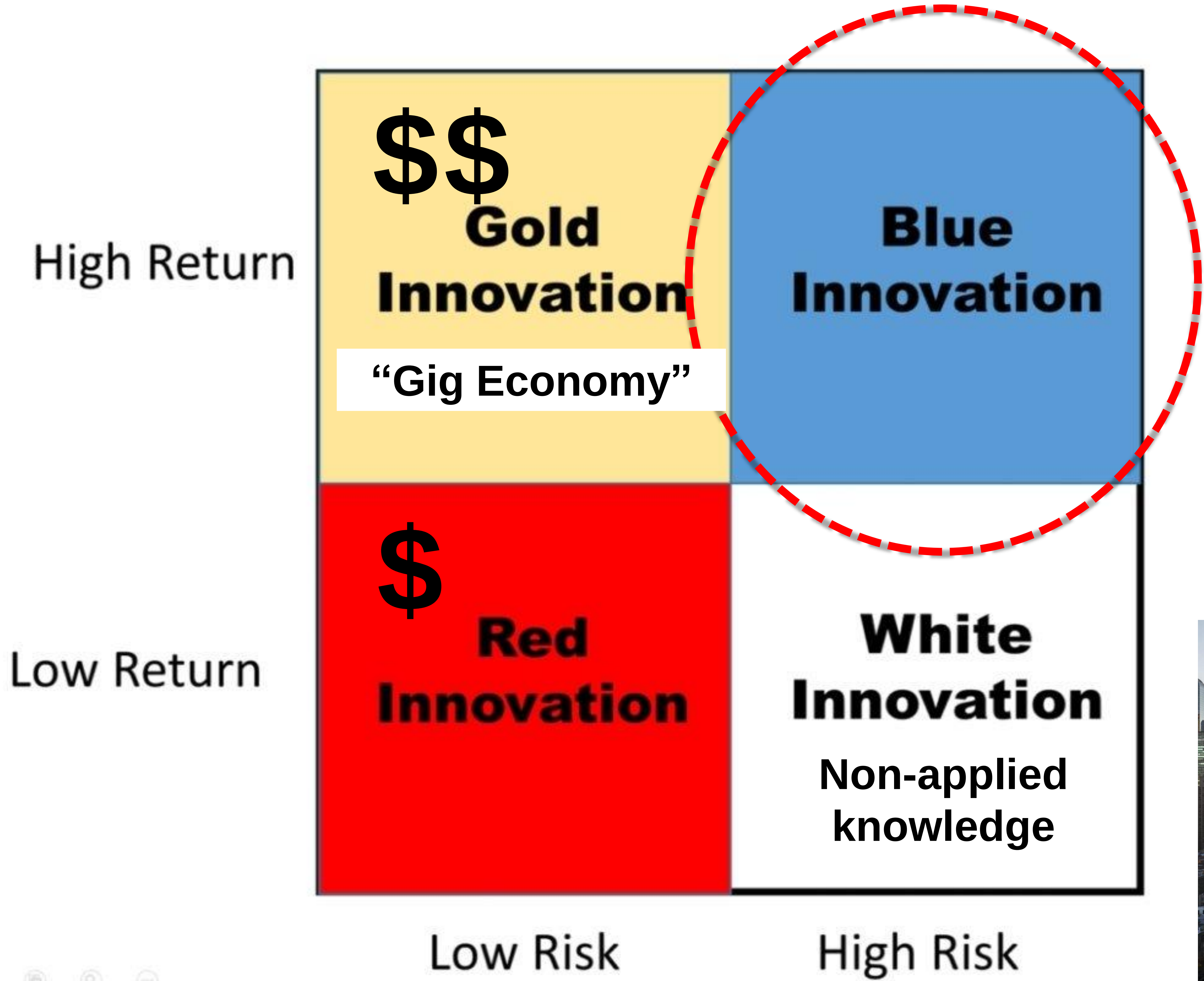
High Risk





**"Execution pays your salary. Innovation pays your pension" (Steve Blank)**

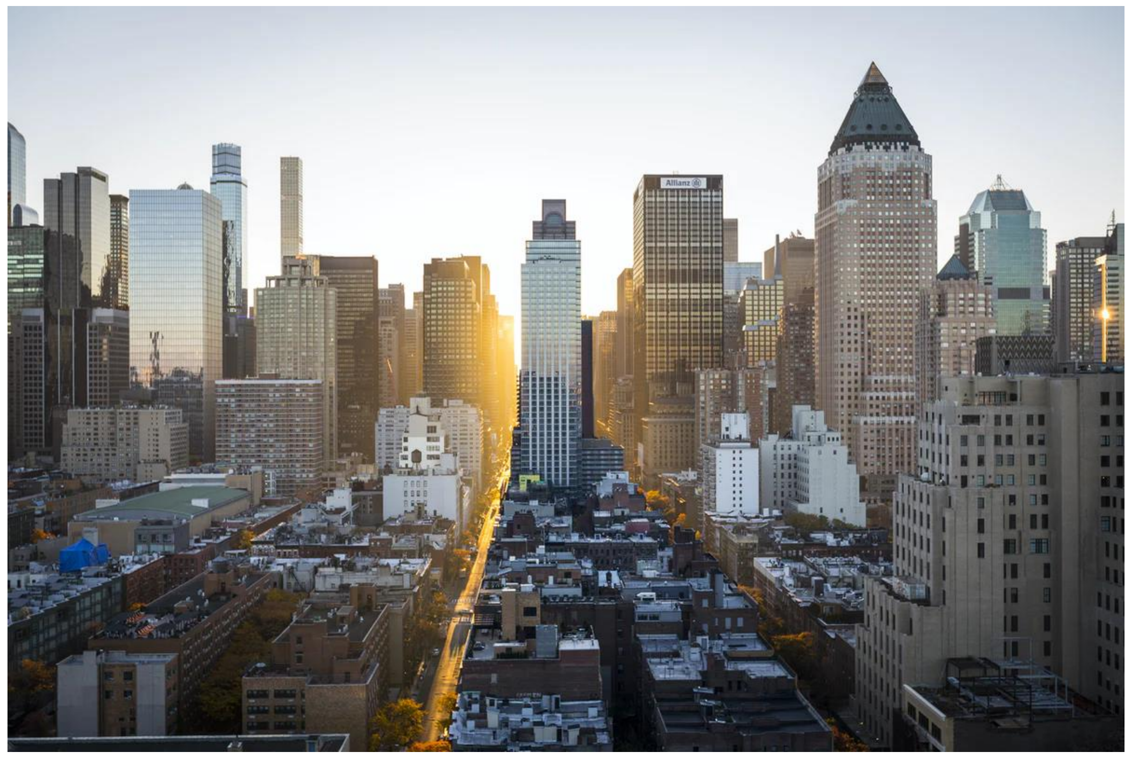
# Implicaciones macroeconómicas




**Economic externalities:**

- **High entry barriers to competition**
- **High margins**
- **Talent and productive investments attraction**
- **Economic growth and quality of employment**

**PROSPERITY**



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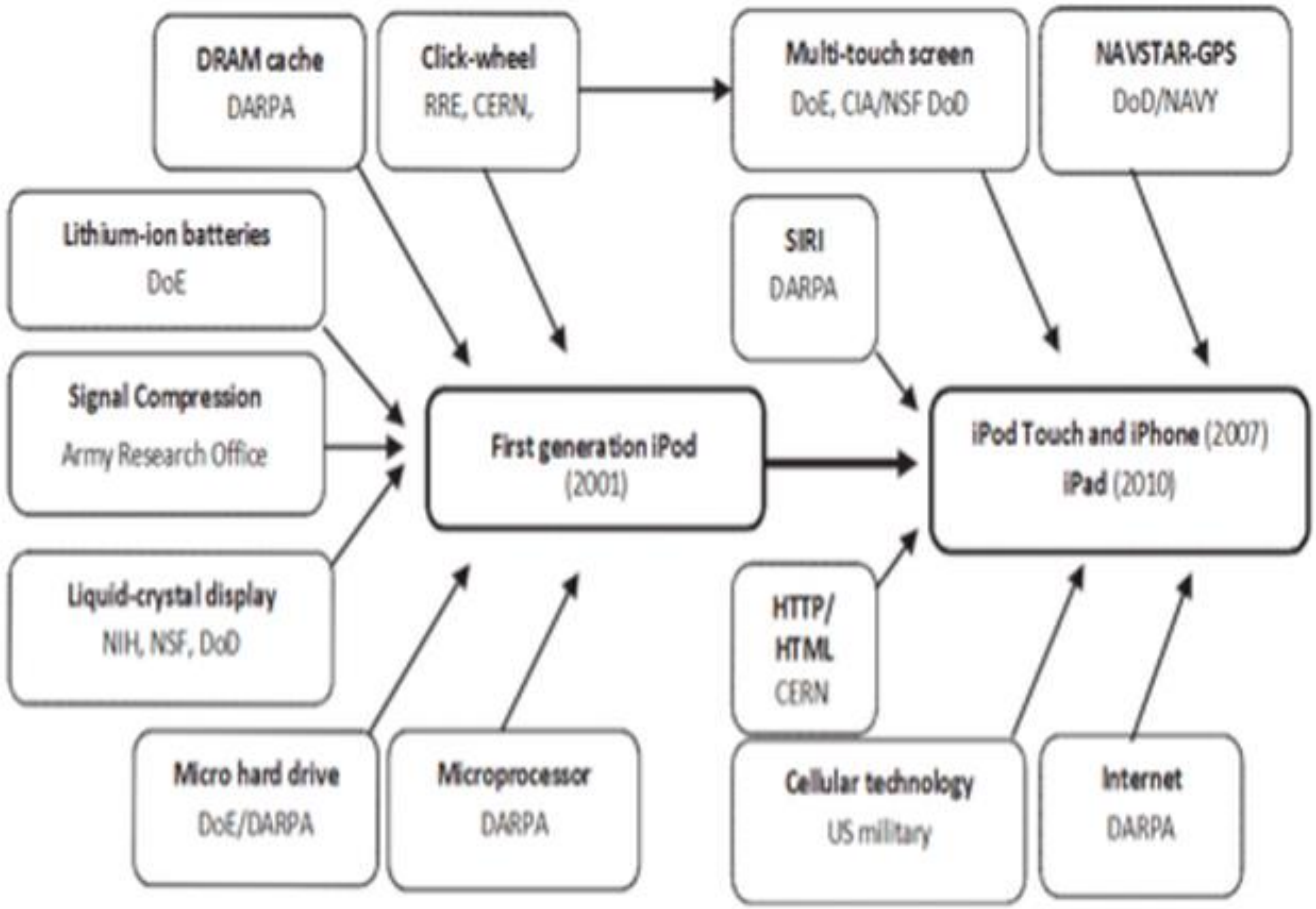
# What makes the iPhone so 'smart'?




source: Mazzucato (2013), p. 109, Fig. 13

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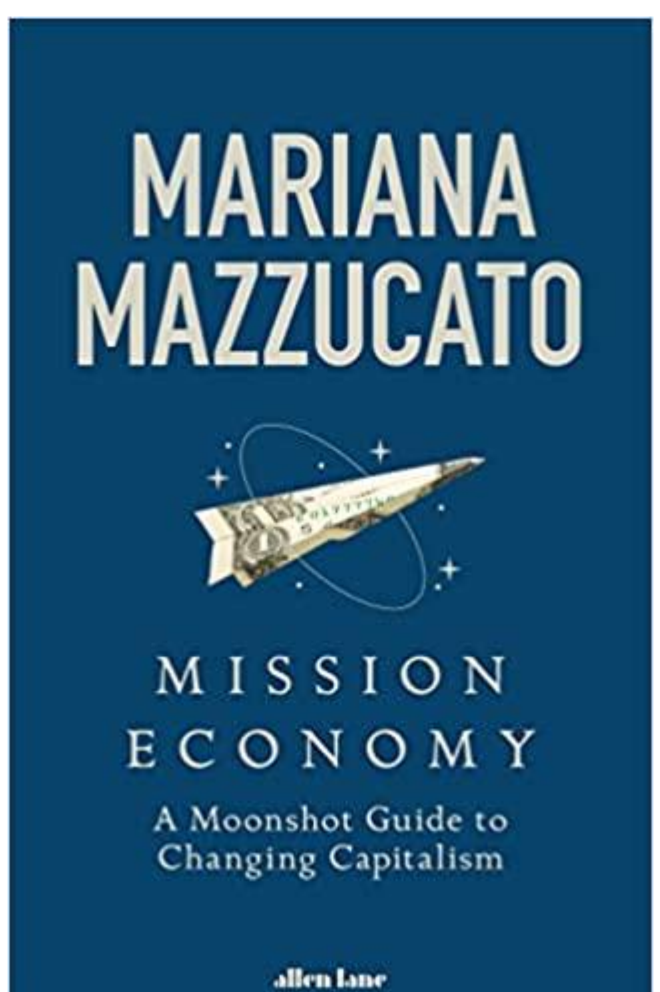
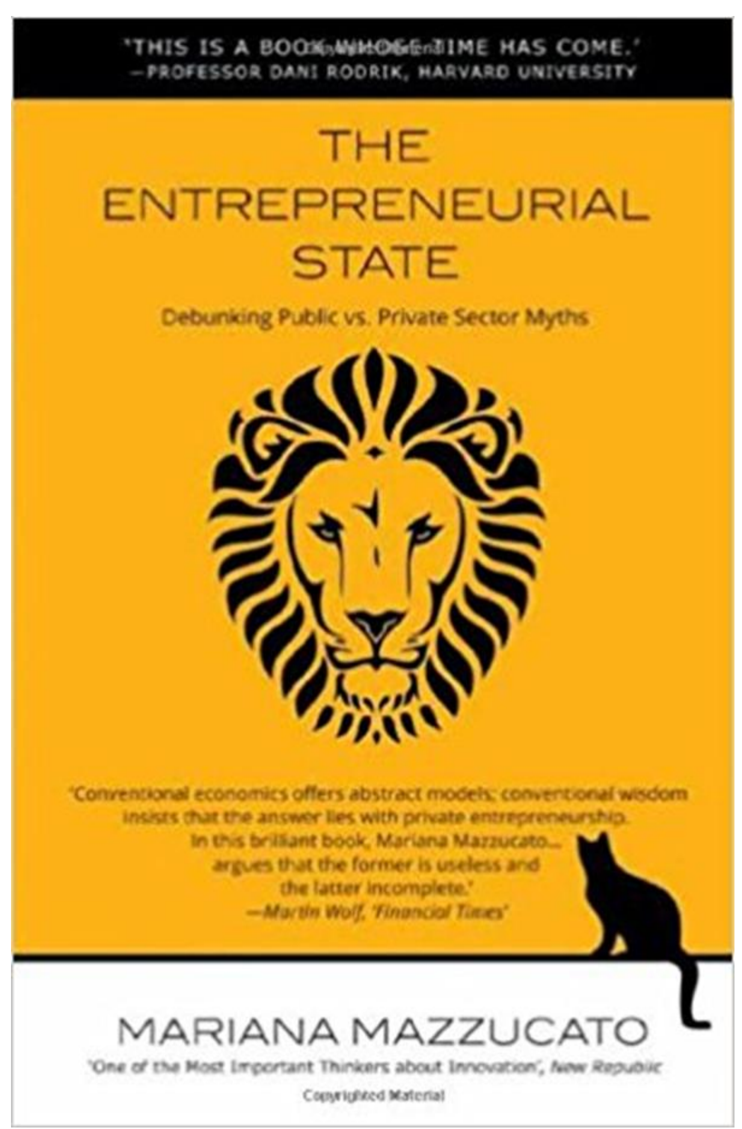
# Cooperación público-privada

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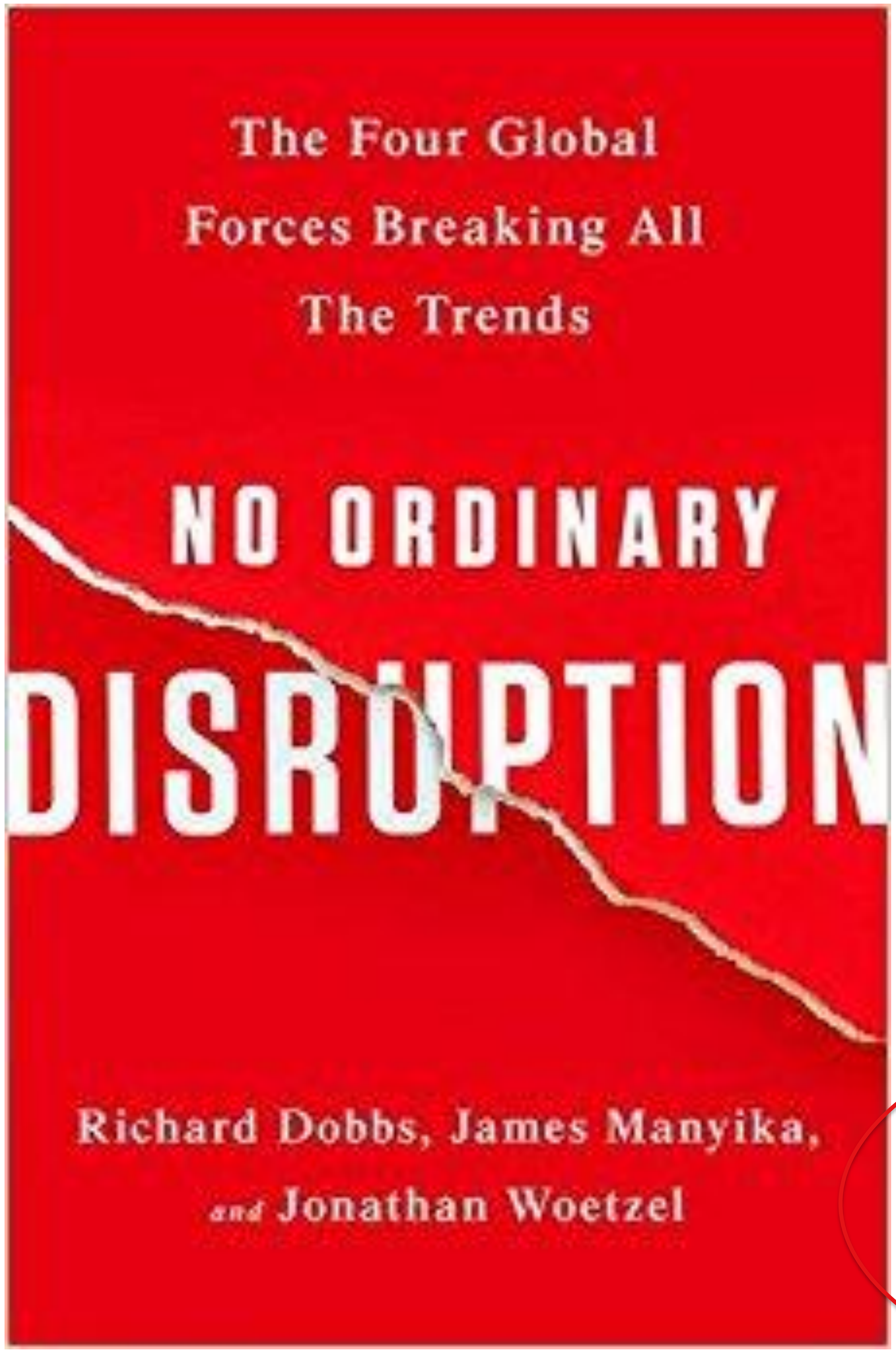
# Tiempos de Innovación Azul




"Comparted with the Industrial Revolution, this change is happening **10 times faster, at 300 times the scale, or 3.000 times the impact**"

"**65 million people** is added annually to the global urban population"

"In Germany, **working population will fall from 54 million (2010) to 36 million (2050)**"

"Capital flows expanded 25 times between 1980 and 2007"

**"12 disruptive technologies arriving together, reinforcing each other, from advanced robotics to the internet of things, new materials or next-generation genomics"**

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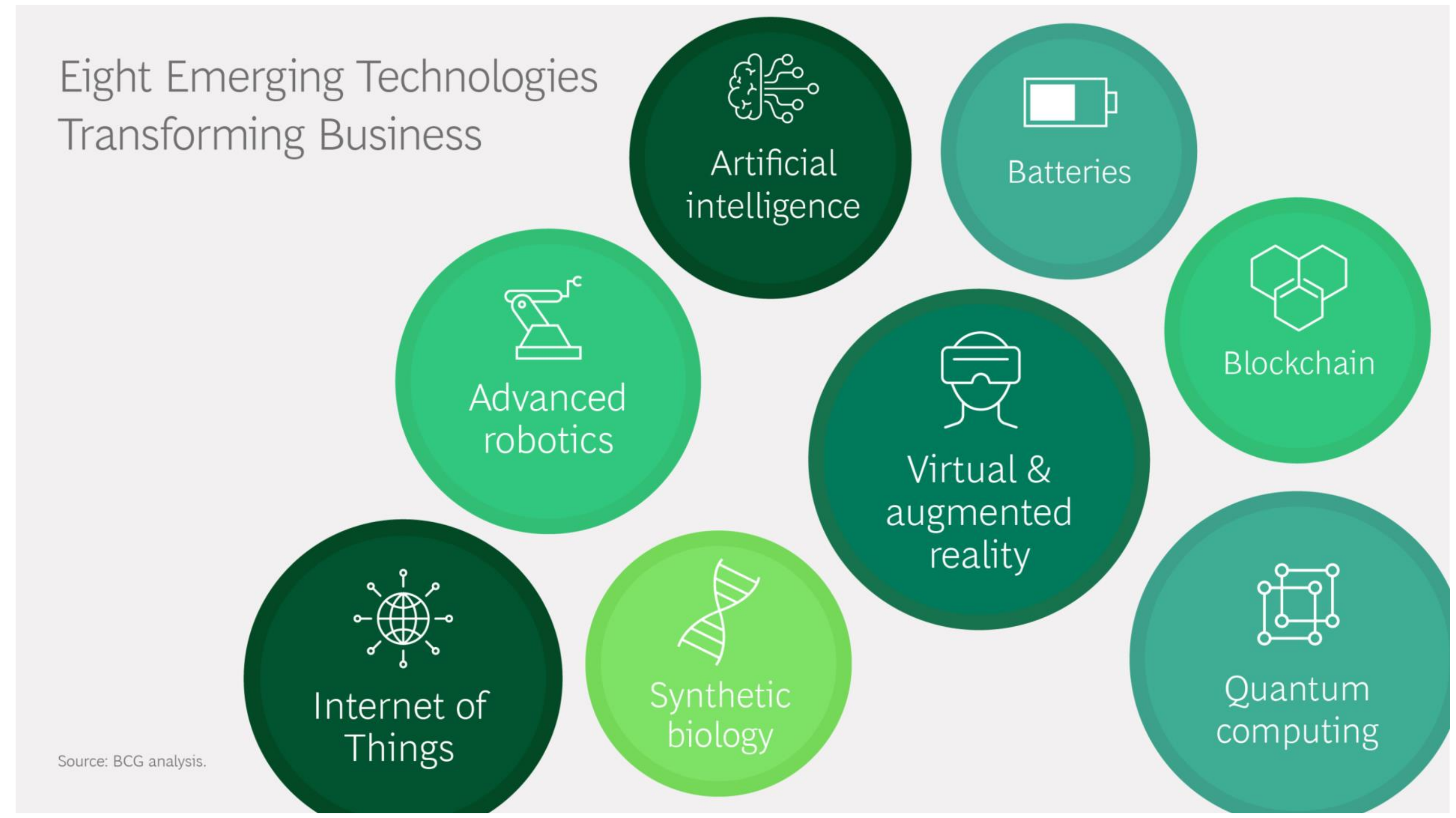
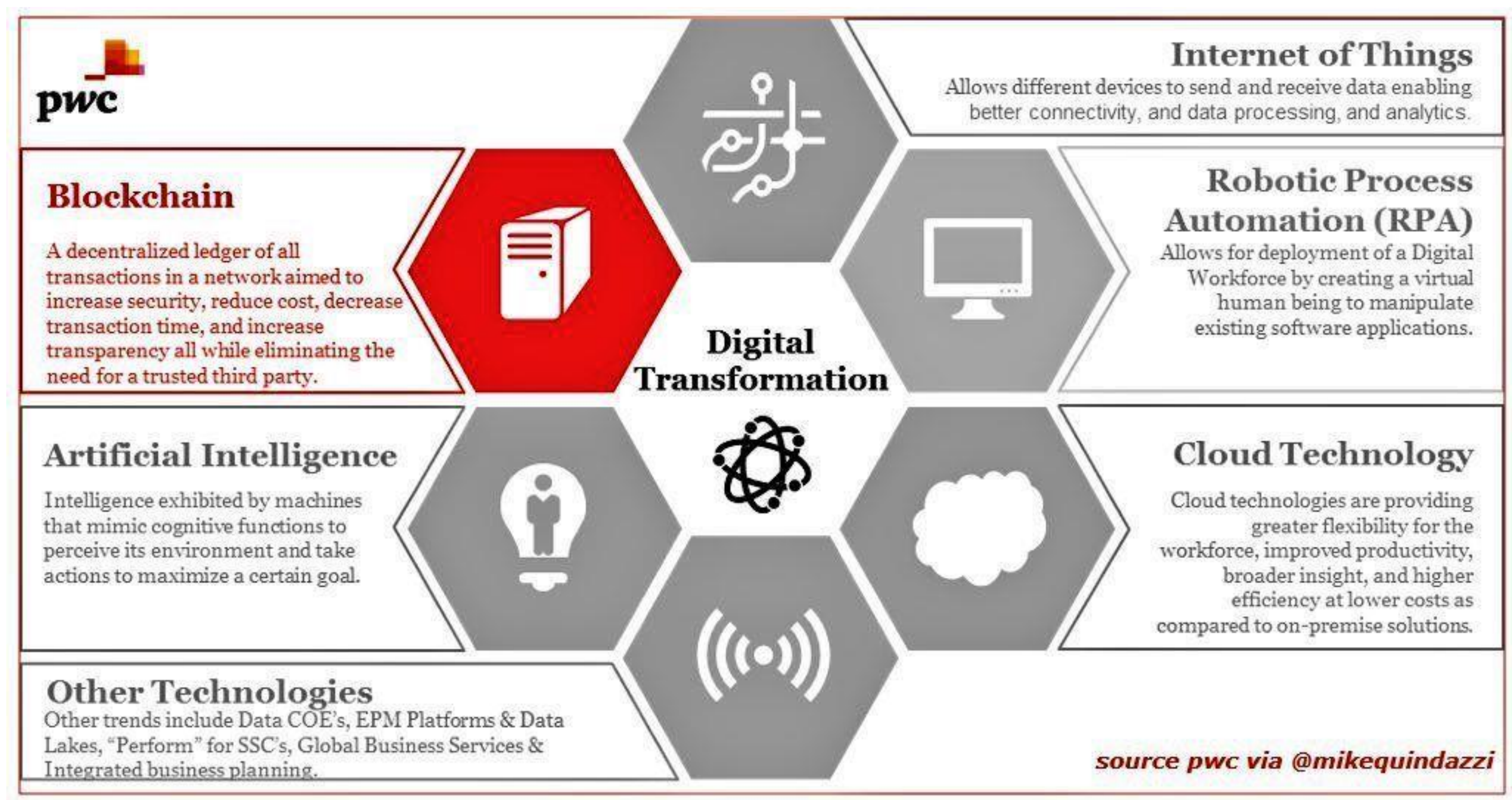
# La Revolución Deep Tech

## Twelve potentially economically disruptive technologies

| | |
|---|---|
| **Mobile Internet** | Increasingly inexpensive and capable mobile computing devices and Internet connectivity |
| **Automation of knowledge work** | Intelligent software systems that can perform knowledge work tasks involving unstructured commands and subtle judgments |
| **The Internet of Things** | Networks of low-cost sensors and actuators for data collection, monitoring, decision making, and process optimization |
| **Cloud technology** | Use of computer hardware and software resources delivered over a network or the Internet, often as a service |
| **Advanced robotics** | Increasingly capable robots with enhanced senses, dexterity, and intelligence used to automate tasks or augment humans |
| **Autonomous and near-autonomous vehicles** | Vehicles that can navigate and operate with reduced or no human intervention |
| **Next-generation genomics** | Fast, low-cost gene sequencing, advanced big data analytics, and synthetic biology ("writing" DNA) |
| **Energy storage** | Devices or systems that store energy for later use, including batteries |
| **3D printing** | Additive manufacturing techniques to create objects by printing layers of material based on digital models |
| **Advanced materials** | Materials designed to have superior characteristics (e.g., strength, weight, conductivity) or functionality |
| **Advanced oil and gas exploration and recovery** | Exploration and recovery techniques that make extraction of unconventional oil and gas economical |
| **Renewable energy** | Generation of electricity from renewable sources with reduced harmful climate impact |

SOURCE: McKinsey Global Institute analysis

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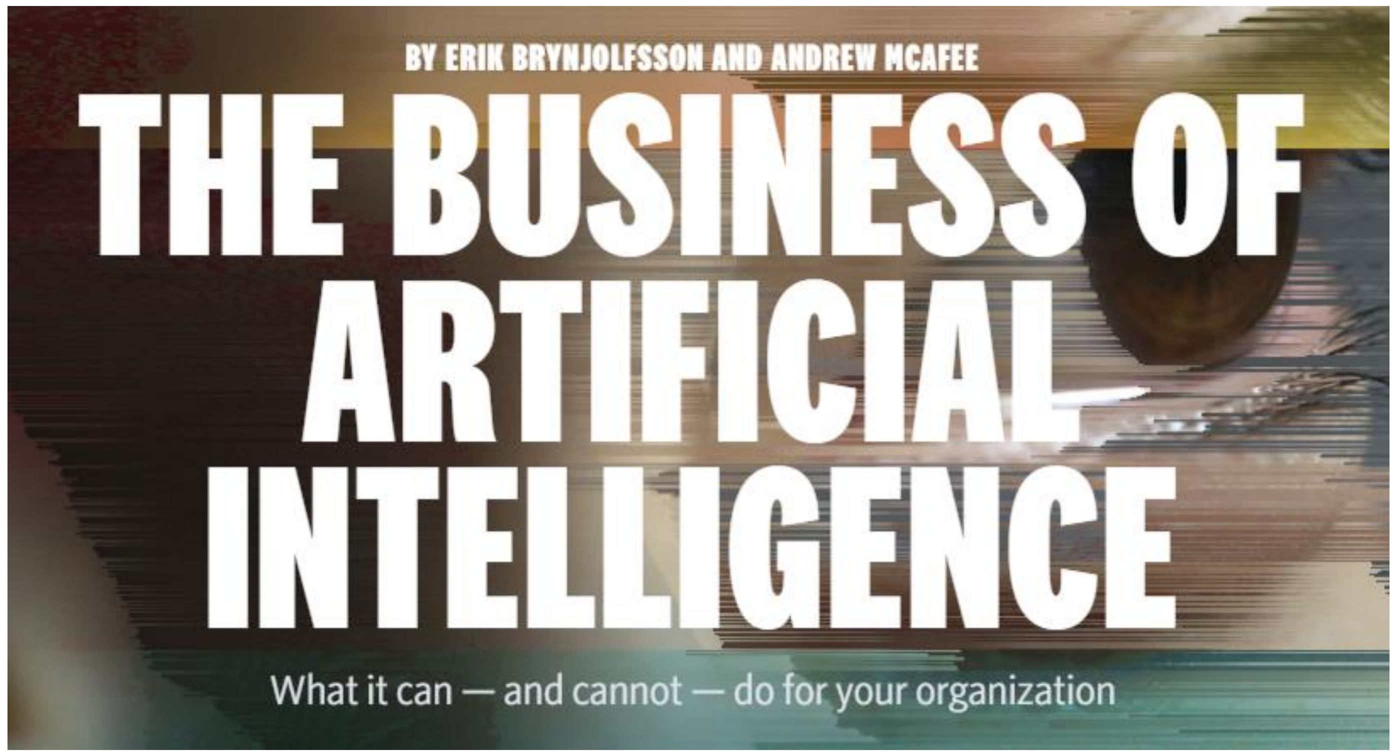
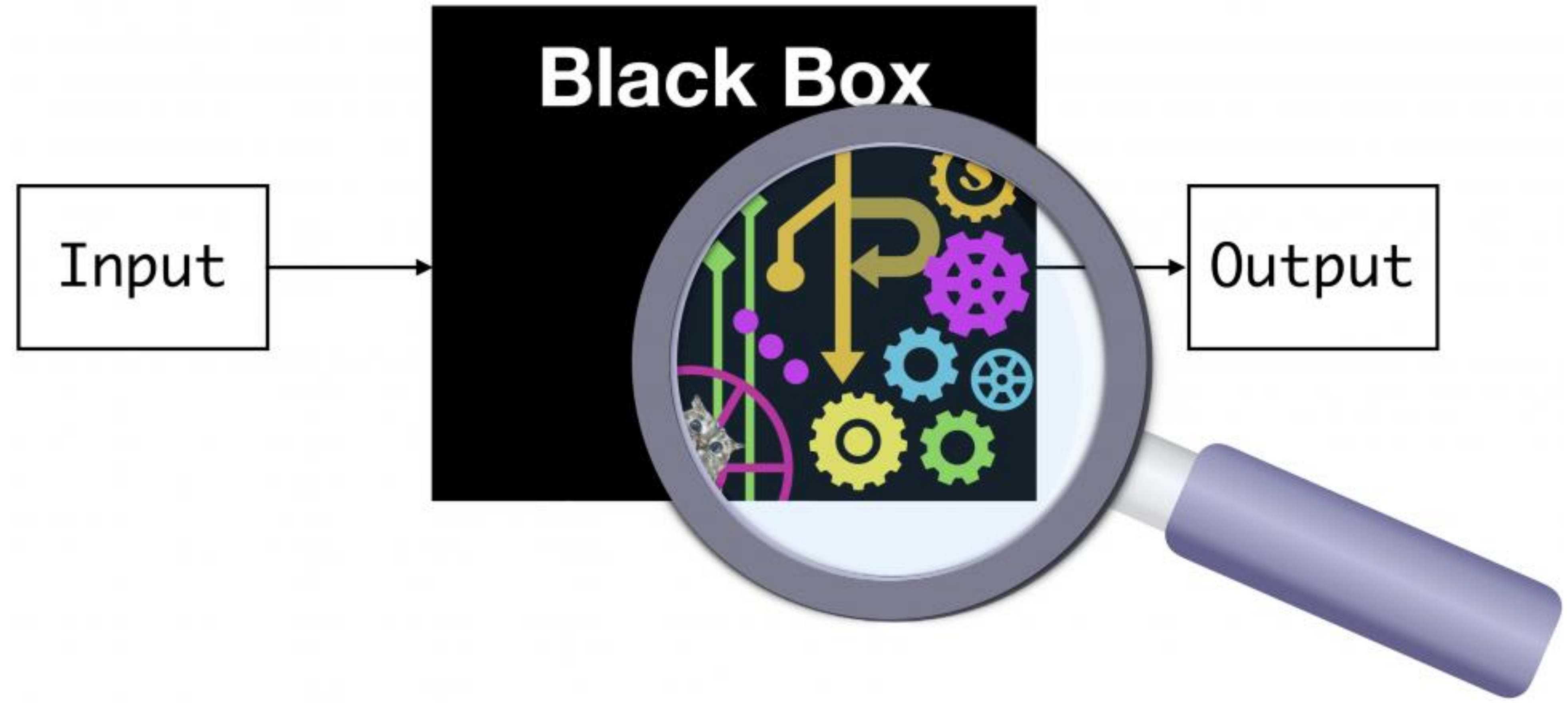
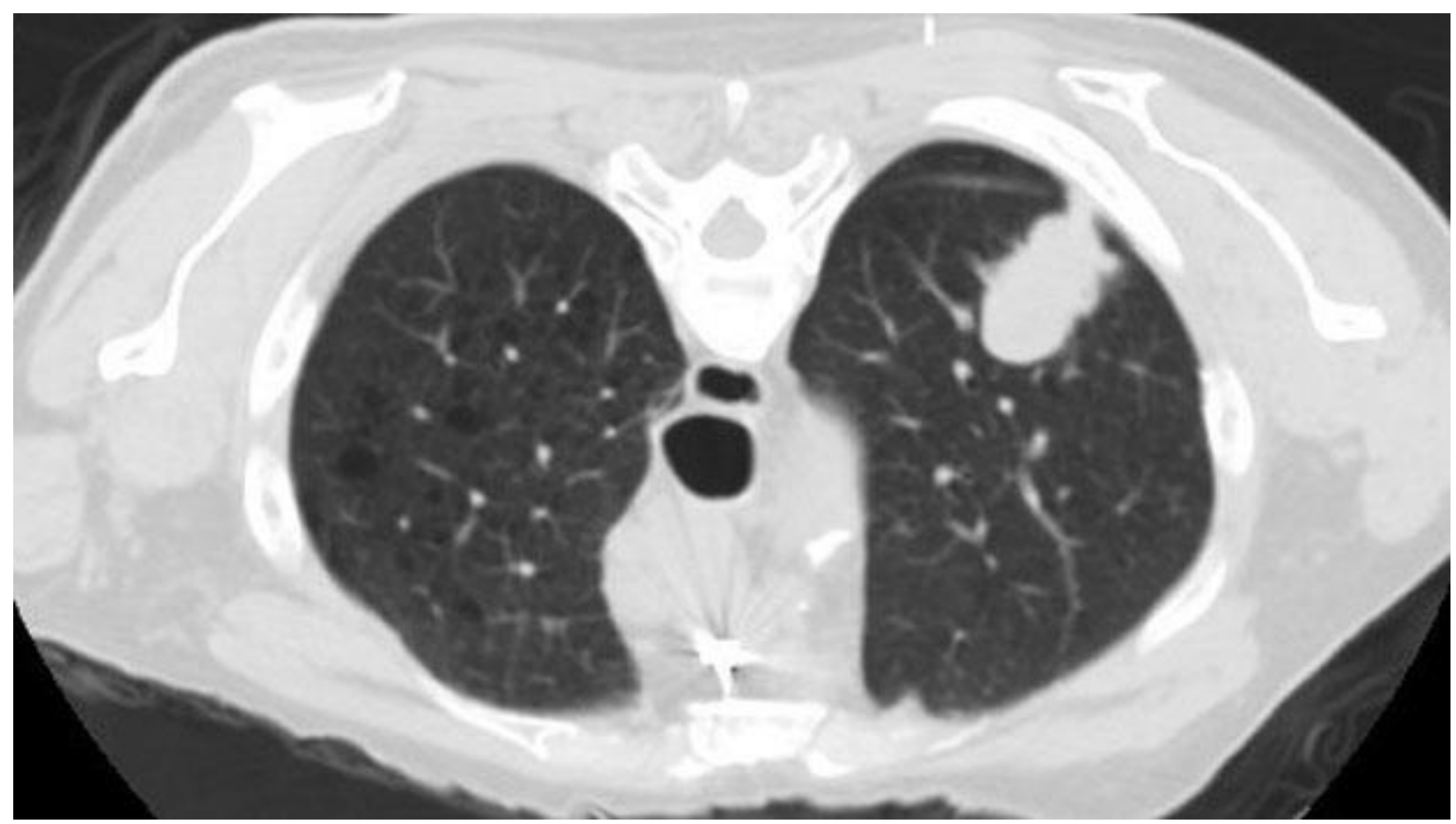
# La paradoja de Polanyi:
# *¿De qué color es esto?*

# Inteligencia Artificial: The Next Big Thing




Artificial intelligence refers to the capability of a machine that is able to replicate or simulate intelligent human behaviours such as analysing and making judgments and decisions



# Inteligencia Artificial: The Next Big Thing

McKinsey & Company

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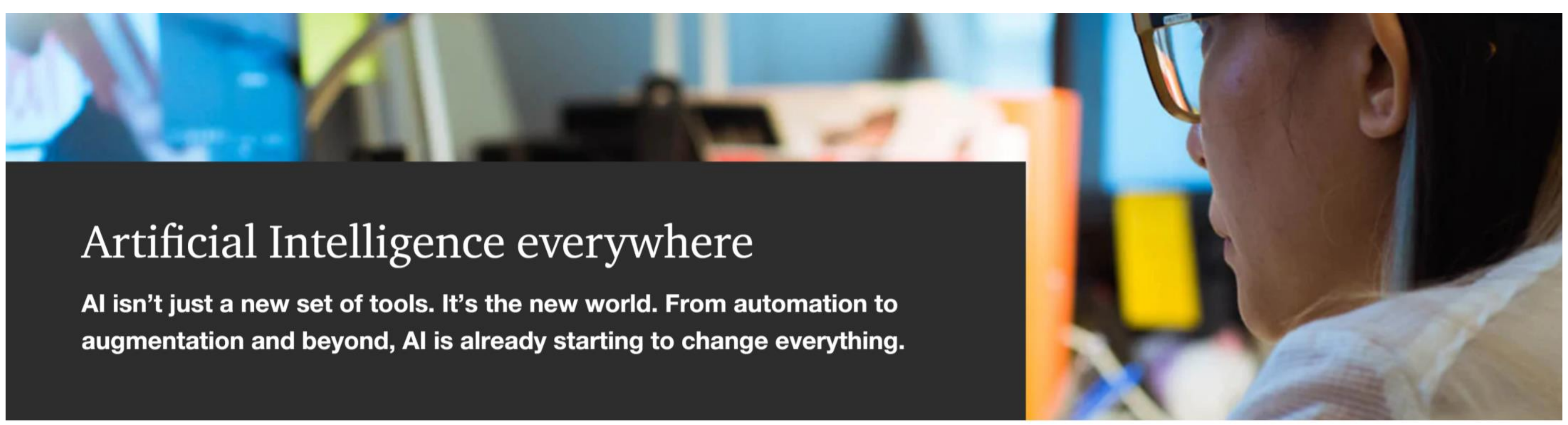
## AI will create $13 trillion in value by 2030

But get ready to change your occupation.

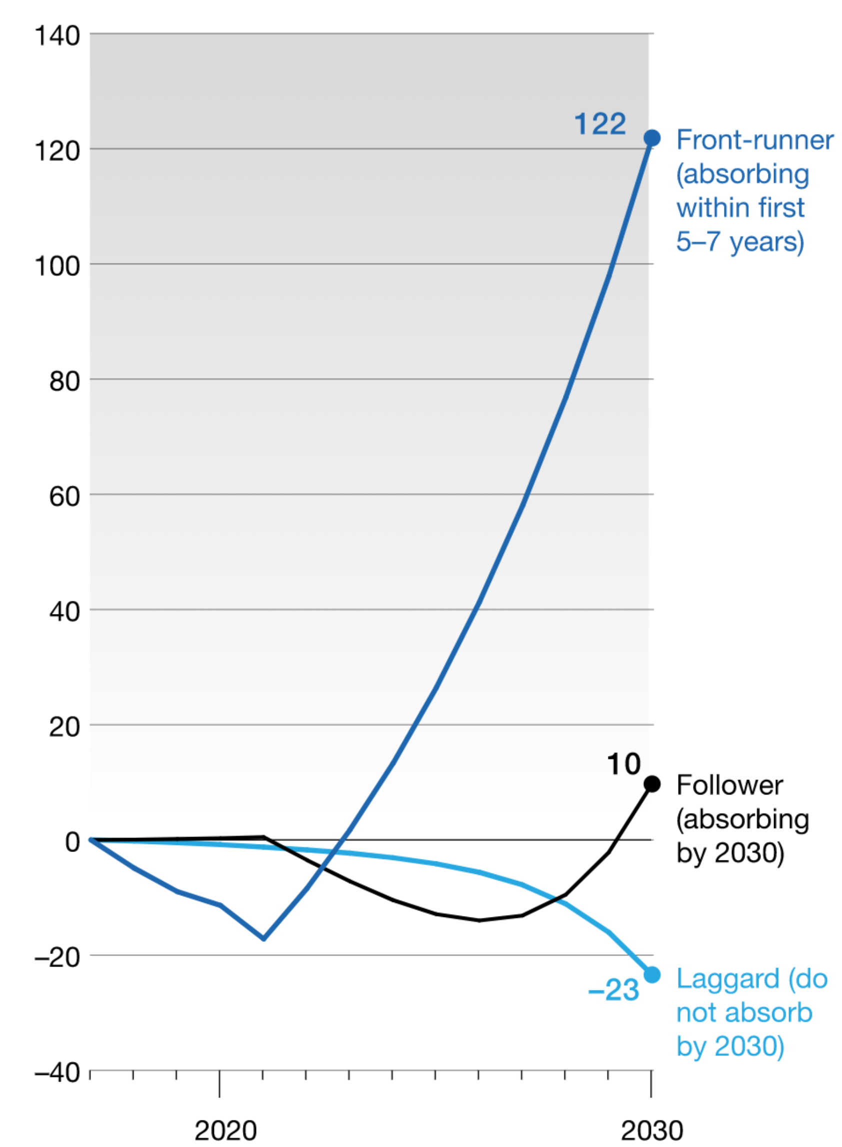



### Big opportunities. Manageable risks.

$15.7 trillion—that's the global economic growth that AI will provide by 2030, according to PwC research. Who will get the biggest share of this prize? Those who take the lead now

Faster AI adoption and absorption by **front-runners** can create larger economic

**Relative changes in cash flow by AI-adoption cohort,** cumulative % change per cohort

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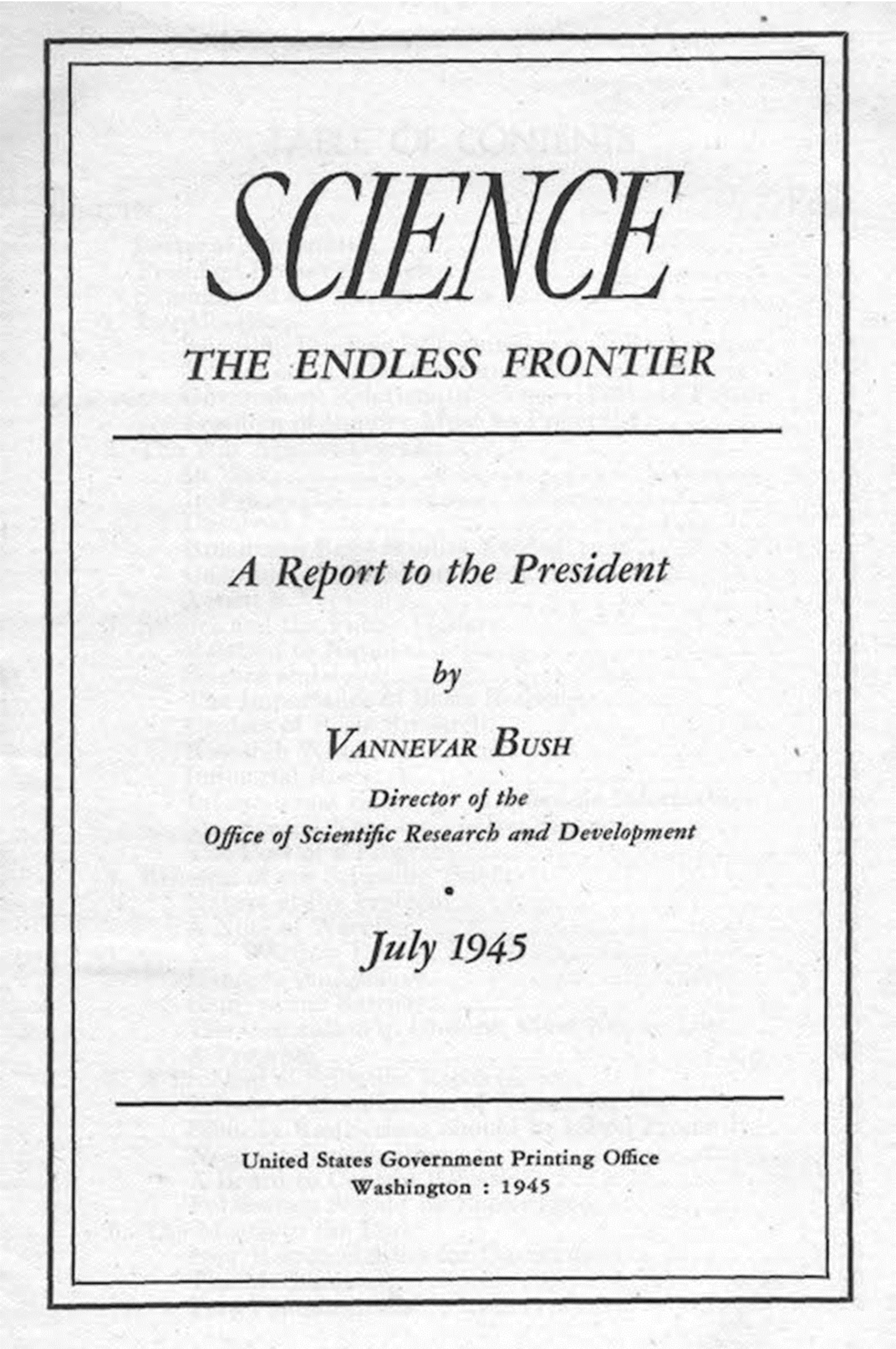
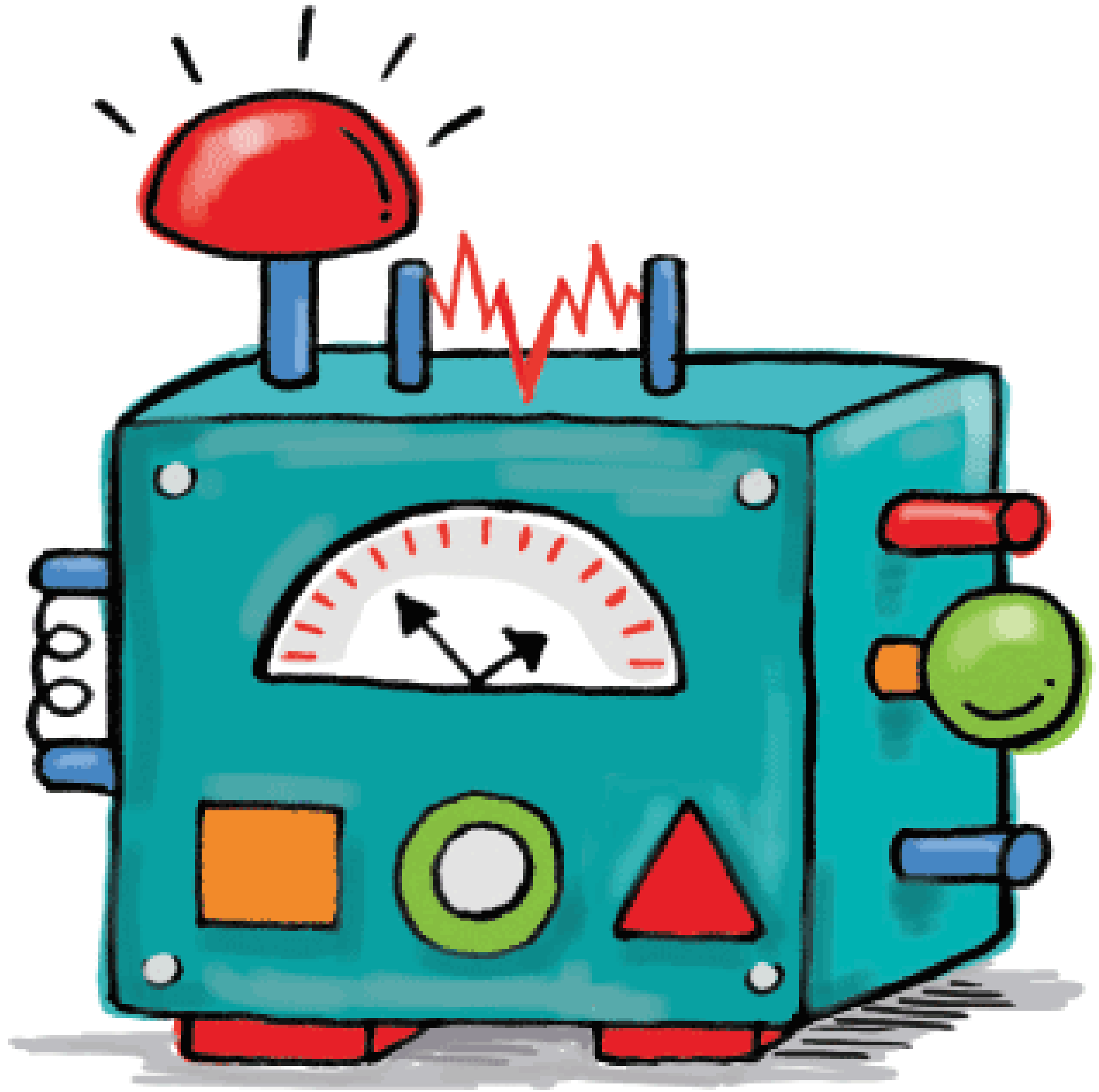
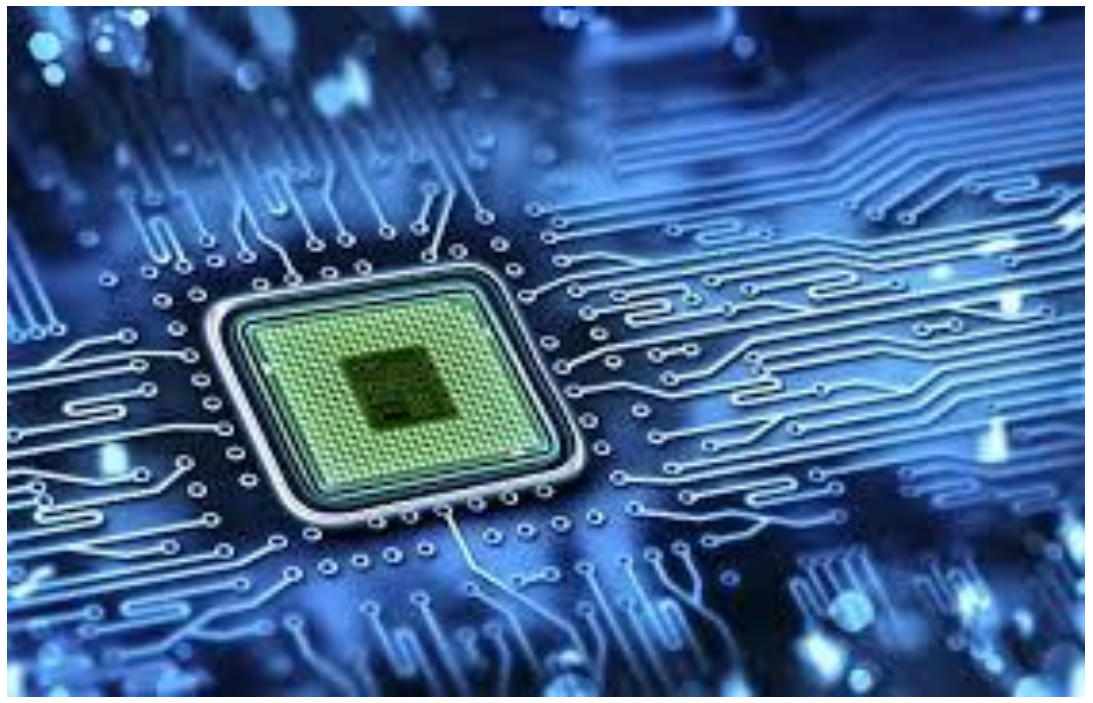
# Covid-19: La Gran Máquina del Tiempo

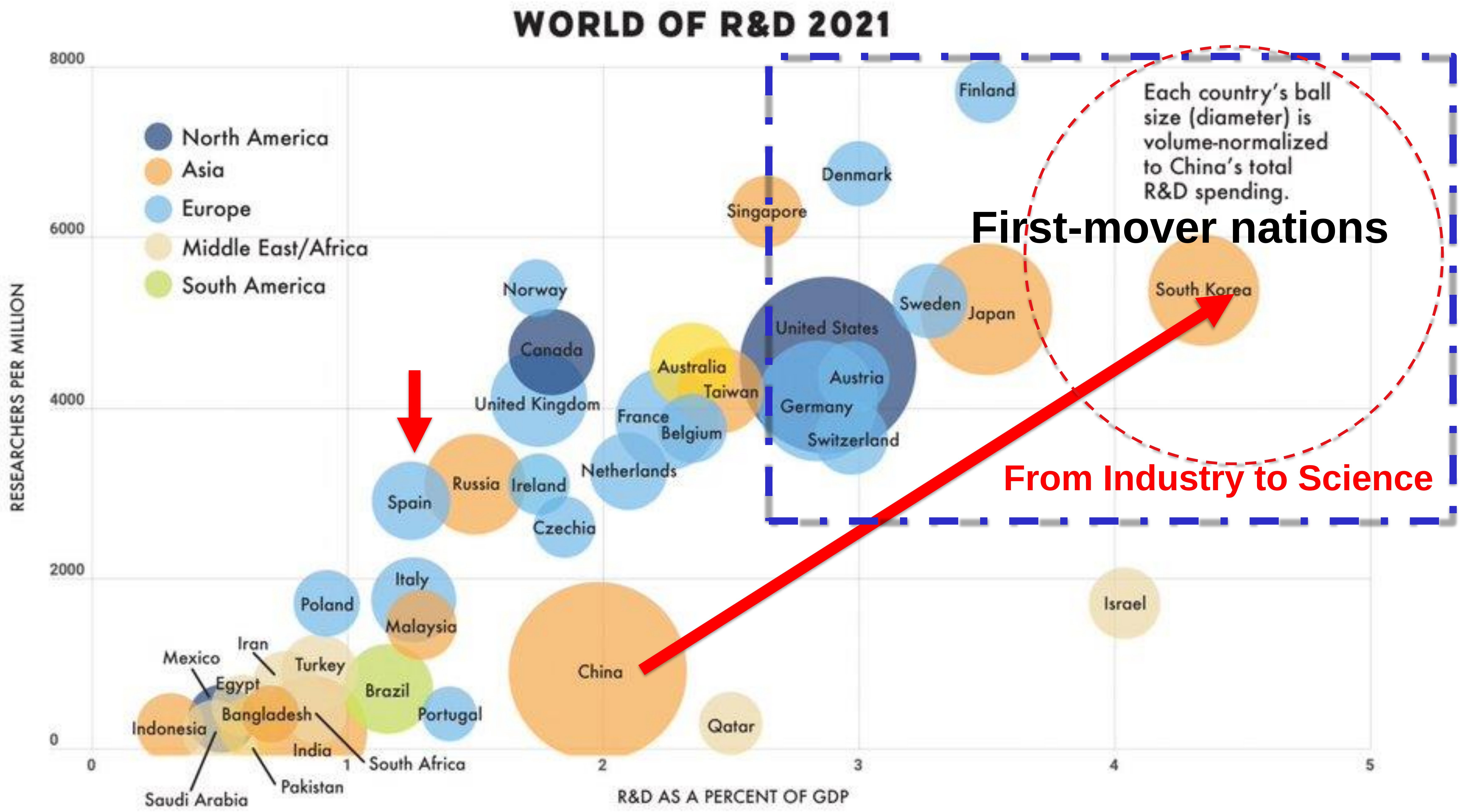

SCIENCE
THE ENDLESS FRONTIER
A Report to the President
by
Vannevar Bush
Director of the
Office of Scientific Research and Development
July 1945
United States Government Printing Office
Washington : 1945

**1945 <-> 2031**





# La Carrera por la Supremacía Tecnológica



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# Hipercompetición en I+D

January 15, 2021

Eric S. Lander, Ph.D.
President and Founding Director
Broad Institute of MIT and Harvard

Dear Dr. Lander:

In 1944, President Franklin D. Roosevelt authored a letter to his science advisor, Dr. Vannevar Bush, posing the question of how science and technology could best be applied to benefit the nation's health, economic prosperity, and national security in the decades that would follow the Second World War. Dr. Bush's response came in the form of a report, titled *Science—the Endless Frontier*, that would form the basis of the National Science Foundation and set the course of scientific discovery in America for the next 75 years.

Those years have brought about some of the most consequential scientific advancements in human history with America leading the way. But three quarters of a century later, the contours of our lives have changed. Technologies and industries have risen and fallen, and the emergence of the digital arena has redefined the ways we innovate, communicate, and experience the world. And the nature of discovery itself has changed by leaps and bounds—reaching celestial heights, and microscopic complexities, that were unimaginable not so long ago.

For this reason, I believe it is essential that we refresh and reinvigorate our national science and technology strategy to set us on a strong course for the *next* 75 years, so that our children and grandchildren may inhabit a healthier, safer, more just, peaceful, and prosperous world. This effort will require us to bring together our brightest minds across academia, medicine, industry, and government—breaking down the barriers that too often limit our vision and our progress, and prioritizing the needs, interests, fears, and aspirations of the American people.

President Roosevelt asked Dr. Bush to consider four specific questions. Today, I am tasking you and your colleagues with five. My hope is that you, working broadly and transparently with the diverse scientific leadership of American society and engaging the broader American public, will make recommendations to our administration on the **general strategies, specific actions, and new structures** that the federal government should adopt to ensure that our nation can continue to harness the full power of science and technology on behalf of the American people.

TECH

## China's spending on research and development hits a record $378 billion

PUBLISHED MON, MAR 1 2021·6:51 AM EST | UPDATED MON, MAR 1 2021·6:57 AM EST

Sam Shead
@SAM_L_SHEAD

SHARE

01 Apr 2021 | News

## Biden unveils historic $325B research and innovation plan

*Massive R&D proposal is part of US President's 'once in a generation' $2.3T infrastructure plan – but opposition will be intense in Congress*

By Éanna Kelly and John McCabe

NEWS | SEMICONDUCTORS

## South Korea's $450-Billion Investment Latest in Chip-Making Push › Ten-year investment part of a global race to secure semiconductors

Photographer: Maurice Tsai/Bloomberg

Technology

## TSMC to Spend $100 Billion Over Three Years to Grow Capacity

By Debby Wu
1 de abril de 2021 3:52 CEST *Updated on 1 de abril de 2021 10:34 CEST*

China / Science

## China's tech hub Shenzhen to invest US$108 billion in R&D over 5 years

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# Un Mundo de Gigacompañías

| Symbol | Company | Cap Rank 9-1-21 | Market Cap 9-1-21 | 1d Chg 9-1-21 | 1m Chg 9-1-21 | 12m Chg 9-1-21 |
|---|---|---|---|---|---|---|
| AAPL | Apple | 1 | 2,521.0 | 0.4% | 4.6% | 13.7% |
| MSFT | Microsoft | 2 | 2,268.2 | 0.0% | 5.9% | 32.8% |
| GOOGL | Alphabet | 3 | 1,940.5 | 0.4% | 7.8% | 75.5% |
| AMZN | Amazon | 4 | 1,761.9 | 0.2% | 4.6% | -0.6% |
| FB | Facebook | 5 | 1,077.2 | 0.7% | 7.2% | 29.3% |
| TSLA | Tesla | 6 | 726.8 | -0.2% | 6.8% | 54.5% |
| BRK.A | Berkshire Hathaway | 7 | 646.2 | 0.0% | 2.6% | 31.3% |
| TSM | Taiwan Semiconductor | 8 | 624.7 | 1.2% | 3.3% | 47.7% |
| NVDA | NVIDIA | 9 | 561.0 | 0.3% | 15.1% | 62.4% |
| V | Visa | 10 | 489.4 | 0.4% | -6.6% | 7.9% |
| JPM | JPMorgan Chase | 11 | 477.3 | -0.1% | 5.2% | 59.5% |
| BABA | Alibaba | 12 | 471.0 | 3.8% | -11.2% | -41.9% |
| JNJ | Johnson & Johnson | 13 | 457.4 | 0.4% | 0.9% | 14.7% |
| WMT | Walmart | 14 | 414.1 | -0.2% | 3.7% | 0.1% |
| UNH | UnitedHealth | 15 | 393.5 | 0.3% | 1.2% | 33.4% |
| PG | Procter & Gamble | 16 | 349.3 | 1.0% | 1.1% | 4.1% |
| BAC | Bank of America | 17 | 346.6 | -1.3% | 7.4% | 60.2% |
| ASML | ASML | 18 | 345.1 | 1.1% | 9.8% | 117.7% |
| MA | Mastercard | 19 | 344.9 | 1.0% | -9.4% | -2.1% |
| HD | Home Depot | 20 | 341.6 | -0.8% | -1.4% | 13.2% |
| PYPL | PayPal | 21 | 336.9 | -0.7% | 4.1% | 37.2% |
| DIS | Disney | 22 | 333.4 | 1.2% | 4.2% | 37.4% |
| ADBE | Adobe | 23 | 317.2 | 0.3% | 7.1% | 26.1% |
| CMCSA | Comcast | 24 | 280.6 | 0.8% | 3.9% | 35.7% |
| CRM | Salesforce | 25 | 262.7 | 1.1% | 10.9% | -4.6% |
| NKE | Nike | 26 | 260.5 | -0.1% | -1.8% | 43.3% |
| PFE | Pfizer | 27 | 258.1 | -0.1% | 7.5% | 24.8% |

**https://www.dogsofthedow.com/largest-companies-by-market-cap.htm**


**Market cap: $ 9 Tn (Japan GDP: $ 5 Tn)**


**"Aggregating data is aggregating power" (Robert Spalding)**

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# Un Mundo de Gigainversiones en I+D

| Company | 2020 R&D Expenditures |
|---|---|
| Amazon (US) | $40.43 Billion |
| Alphabet (US) | $27.3B |
| Huawei (China) | $20B |
| Microsoft (US) | $19.3B |
| Apple (US) | $18.75B |
| Samsung (South Korea) | $17.8B* |
| Intel (US) | $13.28B |
| Alibaba (China) | $7.43B |
| IBM (US) | $6.31B |
| Oracle (US) | $6.07B |
| Qualcomm (US) | $5.98B |

***To have a reference, the total expediture in R&D of the whole Spanish economy is $ 18.5 B***

**https://www.technewsworld.com/story/86977.html**

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# Un Mundo de Gigaclústeres

## Top 100 cluster rankings

| Rank | Cluster name | Economy | PCT applications | Scientific publications | Share of total PCT filings, % | Share of total pubs, % | Total | Rank 2013-17 | Rank change |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Tokyo-Yokohama | JP | 113,244 | 143,822 | 10.81 | 1.66 | 12.47 | 1 | 0 |
| 2 | Shenzhen-Hong Kong-Guangzhou | CN/HK | 72,259 | 118,600 | 6.90 | 1.37 | 8.27 | 2 | 0 |
| 3 | Seoul | KR | 40,817 | 140,806 | 3.90 | 1.63 | 5.52 | 3 | 0 |
| 4 | Beijing | CN | 25,080 | 241,637 | 2.40 | 2.79 | 5.18 | 4 | 0 |
| 5 | San Jose-San Francisco, CA | US | 39,748 | 89,974 | 3.8 | 1.04 | 4.83 | 5 | 0 |
| 6 | Osaka-Kobe-Kyoto | JP | 29,464 | 67,514 | 2.81 | 0.78 | 3.59 | 6 | 0 |
| 7 | Boston-Cambridge, MA | US | 15,458 | 128,964 | 1.48 | 1.49 | 2.96 | 7 | 0 |
| 8 | New York City, NY | US | 12,302 | 137,263 | 1.17 | 1.58 | 2.76 | 8 | 0 |
| 9 | Shanghai | CN | 13,347 | 122,367 | 1.27 | 1.41 | 2.69 | 11 | 2 |
| 10 | Paris | FR | 13,561 | 93,003 | 1.30 | 1.07 | 2.37 | 9 | -1 |
| 11 | San Diego, CA | US | 19,665 | 34,635 | 1.88 | 0.40 | 2.28 | 10 | -1 |
| 12 | Nagoya | JP | 19,327 | 24,582 | 1.85 | 0.28 | 2.13 | 12 | 0 |
| 13 | Washington, DC-Baltimore, MD | US | 4,592 | 119,647 | 0.44 | 1.38 | 1.82 | 13 | 0 |
| 14 | Los Angeles, CA | US | 9,764 | 69,161 | 0.93 | 0.80 | 1.73 | 14 | 0 |
| 15 | London | GB | 4,281 | 107,680 | 0.41 | 1.24 | 1.65 | 15 | 0 |
| 16 | Houston, TX | US | 10,852 | 51,163 | 1.04 | 0.59 | 1.63 | 16 | 0 |
| 17 | Seattle, WA | US | 11,558 | 34,143 | 1.10 | 0.39 | 1.50 | 17 | 0 |
| 18 | Amsterdam-Rotterdam | NL | 4,409 | 78,602 | 0.42 | 0.91 | 1.33 | 18 | 0 |
| 19 | Cologne | DE | 7,827 | 47,161 | 0.75 | 0.54 | 1.29 | 20 | 1 |
| 20 | Chicago, IL | US | 6,167 | 57,976 | 0.59 | 0.67 | 1.26 | 19 | -1 |
| 21 | Nanjing | CN | 1,662 | 84,789 | 0.16 | 0.98 | 1.14 | 25 | 4 |
| 22 | Daejeon | KR | 8,306 | 26,037 | 0.79 | 0.30 | 1.09 | 22 | 0 |
| 23 | Munich | DE | 7,532 | 31,259 | 0.72 | 0.36 | 1.08 | 24 | 1 |
| 24 | Tel Aviv-Jerusalem | IL | 7,076 | 31,086 | 0.68 | 0.36 | 1.03 | 23 | -1 |
| 25 | Hangzhou | CN | 4,832 | 48,627 | 0.46 | 0.56 | 1.02 | 30 | 5 |
| 26 | Stuttgart | DE | 8,336 | 18,241 | 0.80 | 0.21 | 1.01 | 26 | 0 |
| 27 | Taipei-Hsinchu | TW | 2,721 | 62,420 | 0.26 | 0.72 | 0.98 | 43 | 16 |
| 28 | Singapore | SG | 4,019 | 46,037 | 0.38 | 0.53 | 0.92 | 28 | [illegible] |
| 29 | Wuhan | CN | 1,796 | 63,837 | 0.17 | 0.74 | 0.91 | 38 | 9 |
| 30 | Minneapolis, MN | US | 6,444 | 25,157 | 0.62 | 0.29 | 0.91 | 27 | -3 |
| 31 | Philadelphia, PA | US | 3,173 | 50,847 | 0.30 | 0.59 | 0.89 | 29 | -2 |
| 32 | Moscow | RU | 2,060 | 58,153 | 0.20 | 0.67 | 0.87 | 33 | 1 |
| 33 | Stockholm | SE | 5,736 | 27,409 | 0.55 | 0.32 | 0.86 | 32 | -1 |
| 34 | Eindhoven | BE/NL | 8,226 | 6,067 | 0.79 | 0.07 | 0.86 | 31 | -3 |
| 35 | Melbourne | AU | 1,975 | 56,632 | 0.19 | 0.65 | 0.84 | 35 | 0 |
| 36 | Raleigh, NC | US | 2,949 | 47,499 | 0.28 | 0.55 | 0.83 | 34 | -2 |
| 37 | Sydney | AU | 2,498 | 49,298 | 0.24 | 0.57 | 0.81 | 37 | 0 |
| 38 | Frankfurt Am Main | DE | 5,167 | 24,848 | 0.49 | 0.29 | 0.78 | 36 | -2 |
| 39 | Toronto, ON | CA | 2,336 | 48,017 | 0.22 | 0.55 | 0.78 | 39 | 0 |
| 40 | Xi'an | CN | 775 | 60,017 | 0.07 | 0.69 | 0.77 | 47 | 7 |

Global Innovation Index (WIPO)

**Un nuevo modelo de globalización: de la externalización en costes a la atracción de innovación**

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# Un Mundo de Gigafactorías

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**SEMICONDUCTORS**

## TSMC eyes Germany as possible location for first Europe chip plant

Taiwanese chipmaker looking at ways to lower costs at planned Japan factory


## Germany: Tesla seeks to build battery factory near Berlin

Tesla has also changed its application for emission control approval for its construction plans. The new application formally requests the additional battery production facility Tesla had already hinted at.

## VW partners with Chinese company for German battery factory

Automaker aims to be top three global battery manufacturer

NATHAN EDDY

REUTERS® | World | Business | Legal | Markets | Breakingviews | Technology | Investigations | Sports | More

June 18, 2021
2:56 PM CEST
Last Updated 3 months ago

2 minute read

**Business**

## German state of Bavaria in talks with Intel on chip megafactory

Reuters


## BASF, Porsche partner on battery development

**Published date:** 21 July 2021

**Share:**

German chemicals producer BASF and Cellforce Group, a joint venture between Porsche and Custom Cells, have agreed to develop high-performance battery cells for electric vehicles (EVs).

## Bosch opens $1.2 billion chip plant in Germany

# Cadenas de suministro fragmentadas


Supply Chain

## Why We're in the Midst of a Global Semiconductor Shortage

by Bindiya Vakil and Tom Linton

February 26, 2021

CNBC

Search quot

MARKETS BUSINESS INVESTING TECH POLITICS CNBC TV WATCHLIST CRAMER PRO

AUTOS

## Chip shortage expected to cost auto industry $210 billion in revenue in 2021

PUBLISHED THU, SEP 23 2021•12:01 AM EDT | UPDATED THU, SEP 23 2021•8:42 AM EDT

Michael Wayland
@MIKEWAYLAND

SHARE

Autos & Transportation

## Volkswagen CEO: 100,000 cars lost due to chip shortage

Reuters

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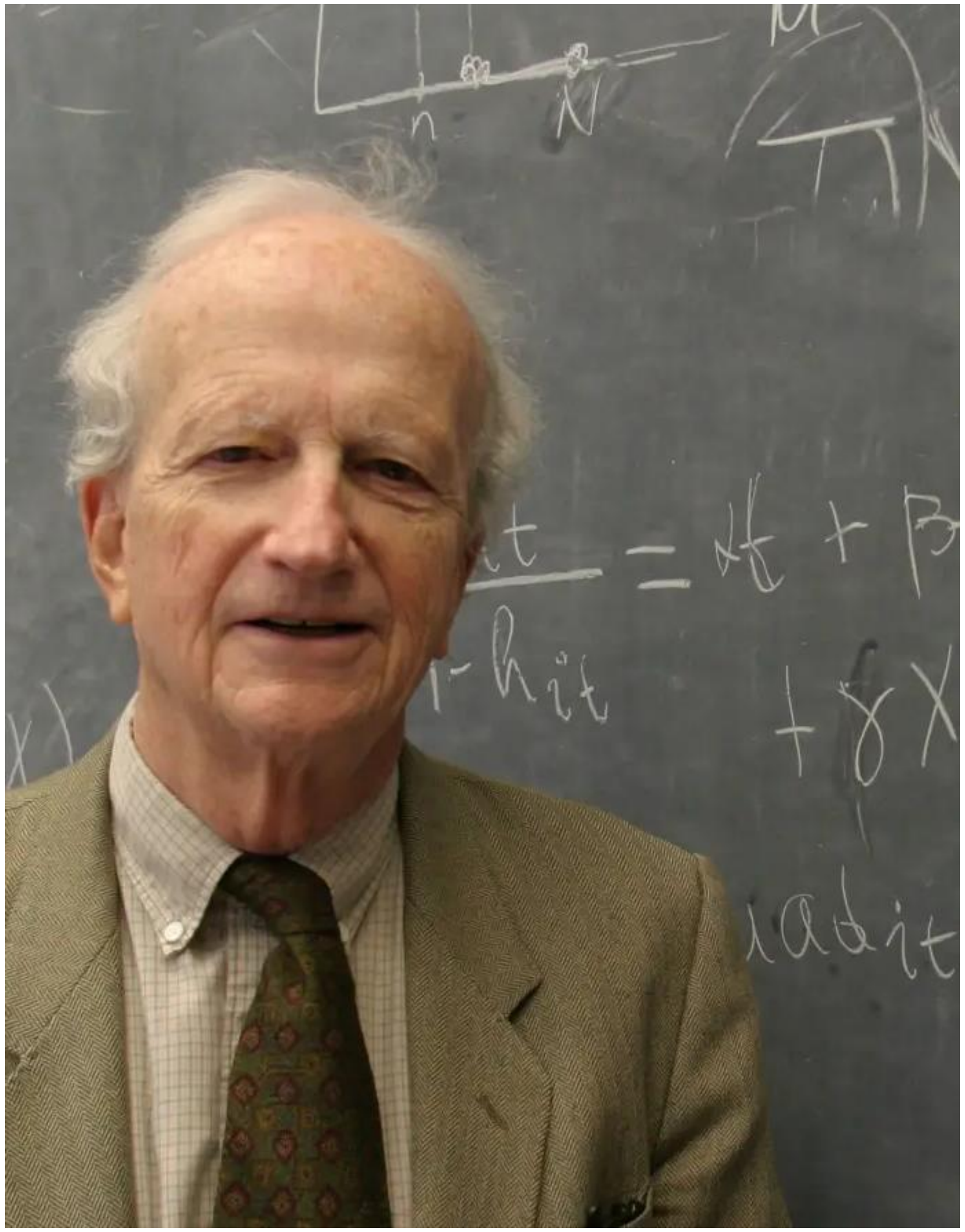
# Tecno-Nacionalismo versus Fundamentalismo de Mercado



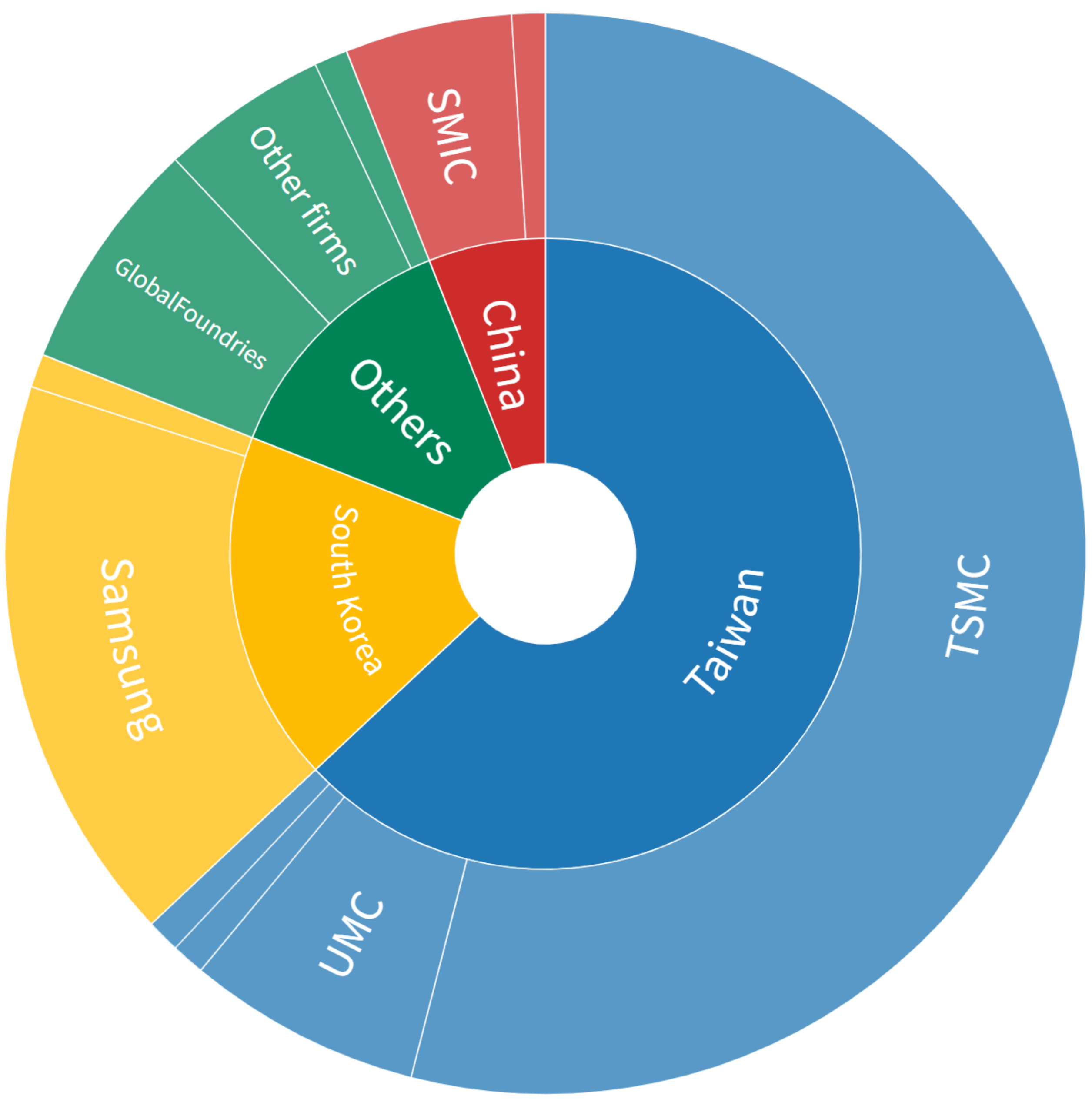
**Gary Becker, Nobel Prize**
**“The best industrial policy is none at all”**

SOURCE / ECONOMY

## China to develop 10,000 ‘little giants’ in push for advanced manufacturing

‘Hidden champions’ key to closing gaps in advanced manufacturing with West

CNBC **2 charts show how much the world depends on Taiwan for semiconductors**

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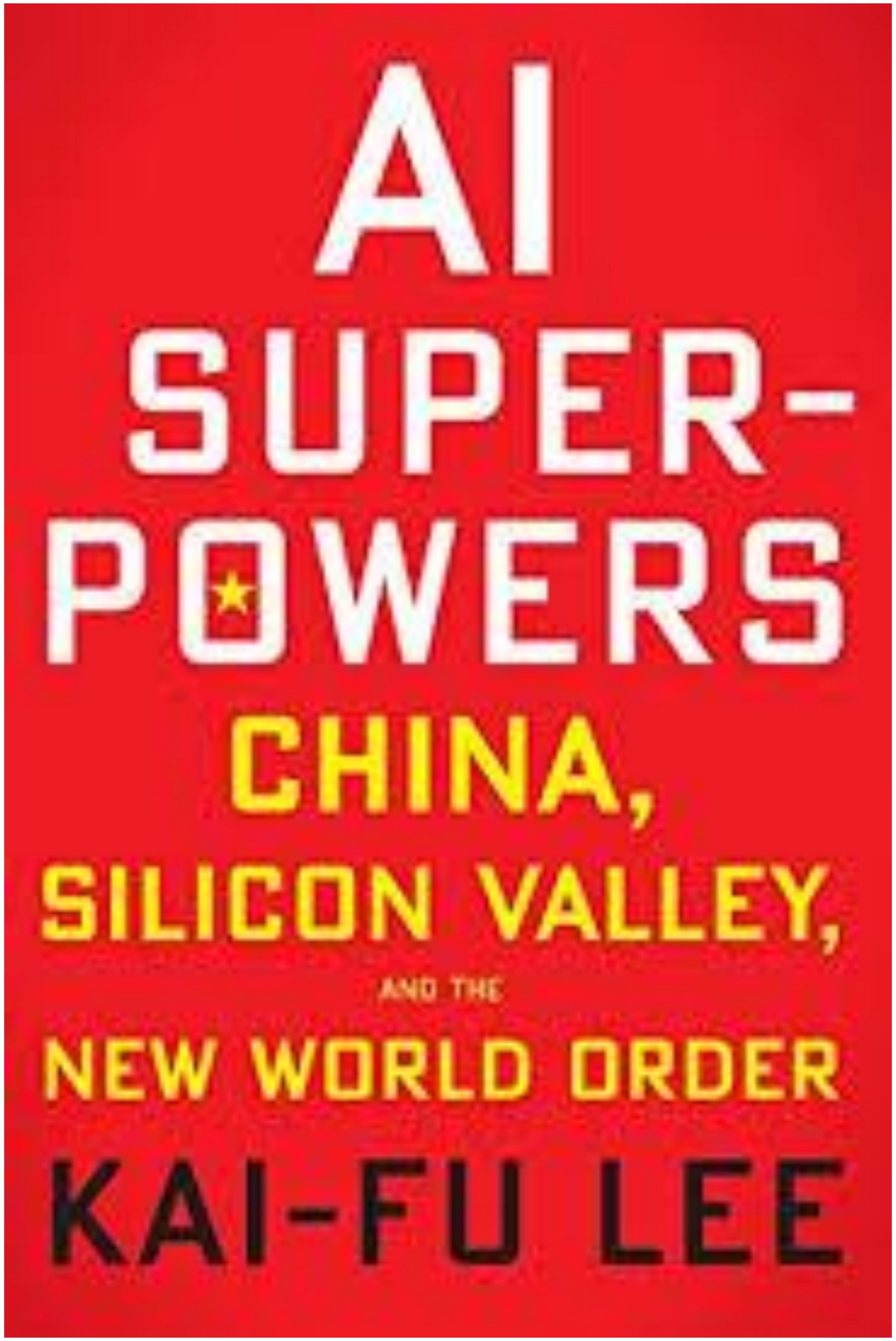


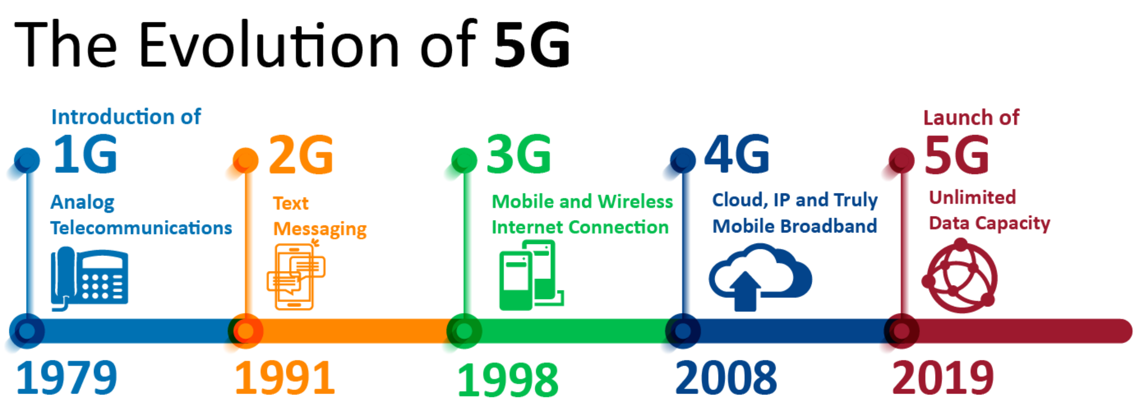


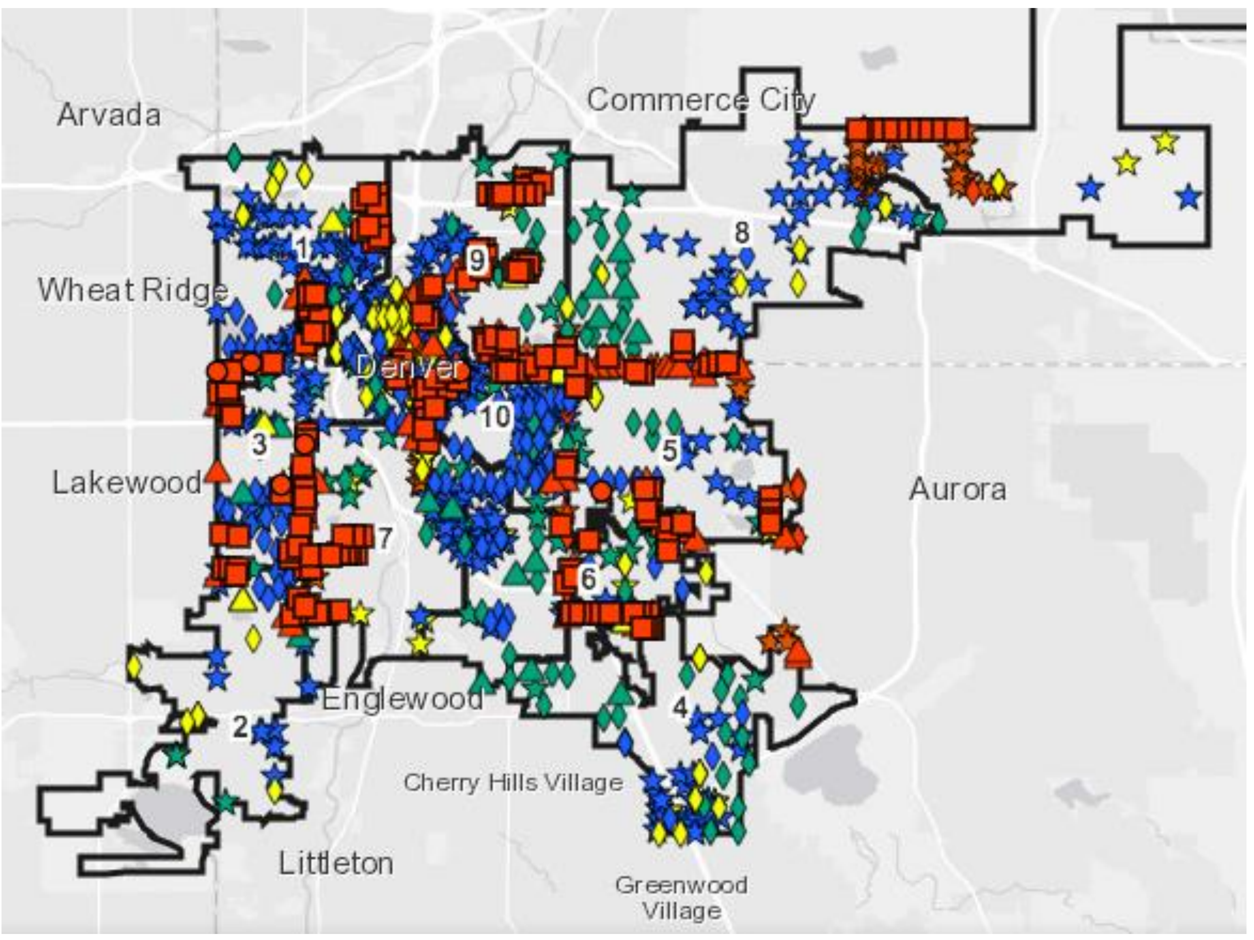
SOURCE / ECONOMY

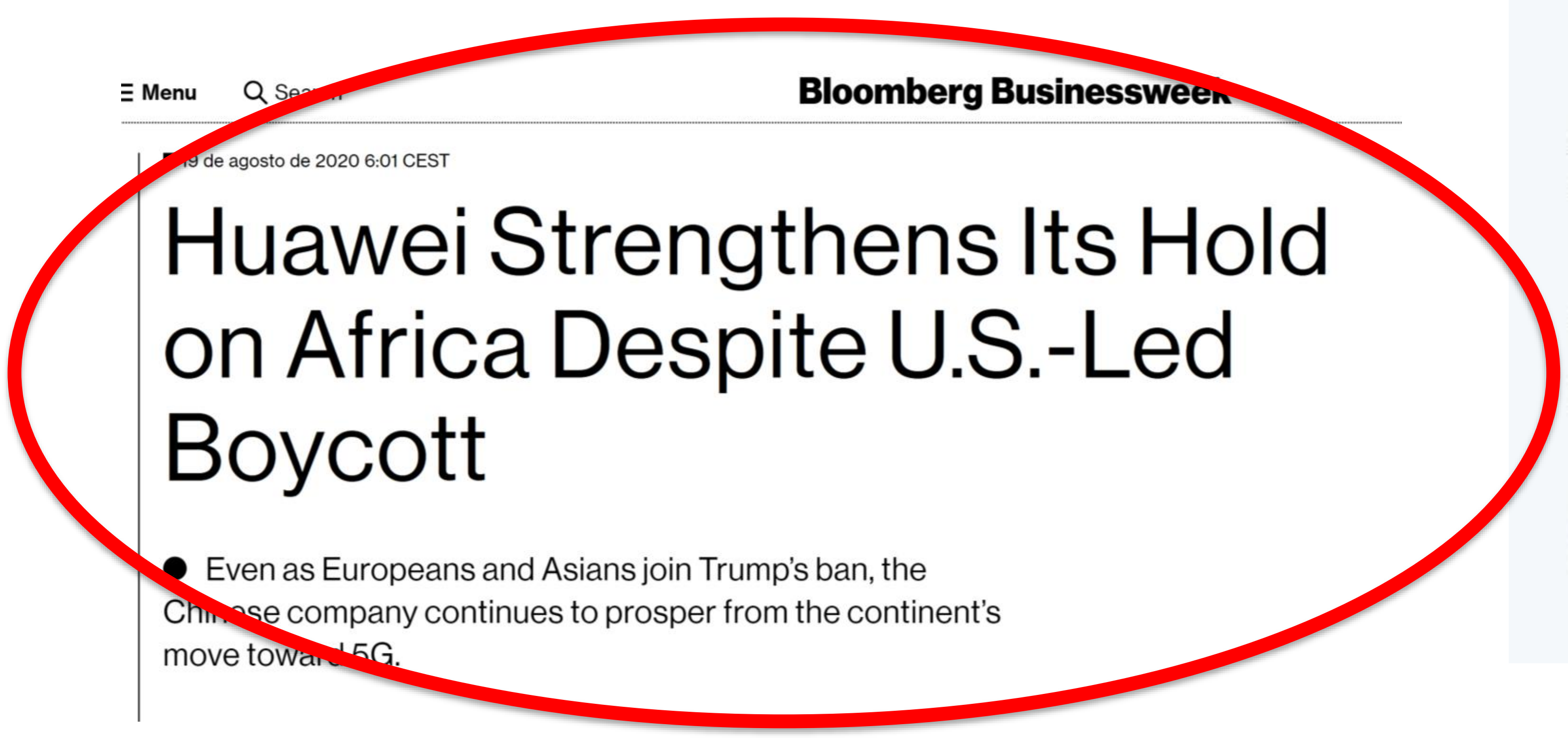
## China rolls out 916,000 5G stations, making up 70% of global total

By Global Times
Published: Jul 13, 2021 03:13 PM


5G Photo:Xinhua

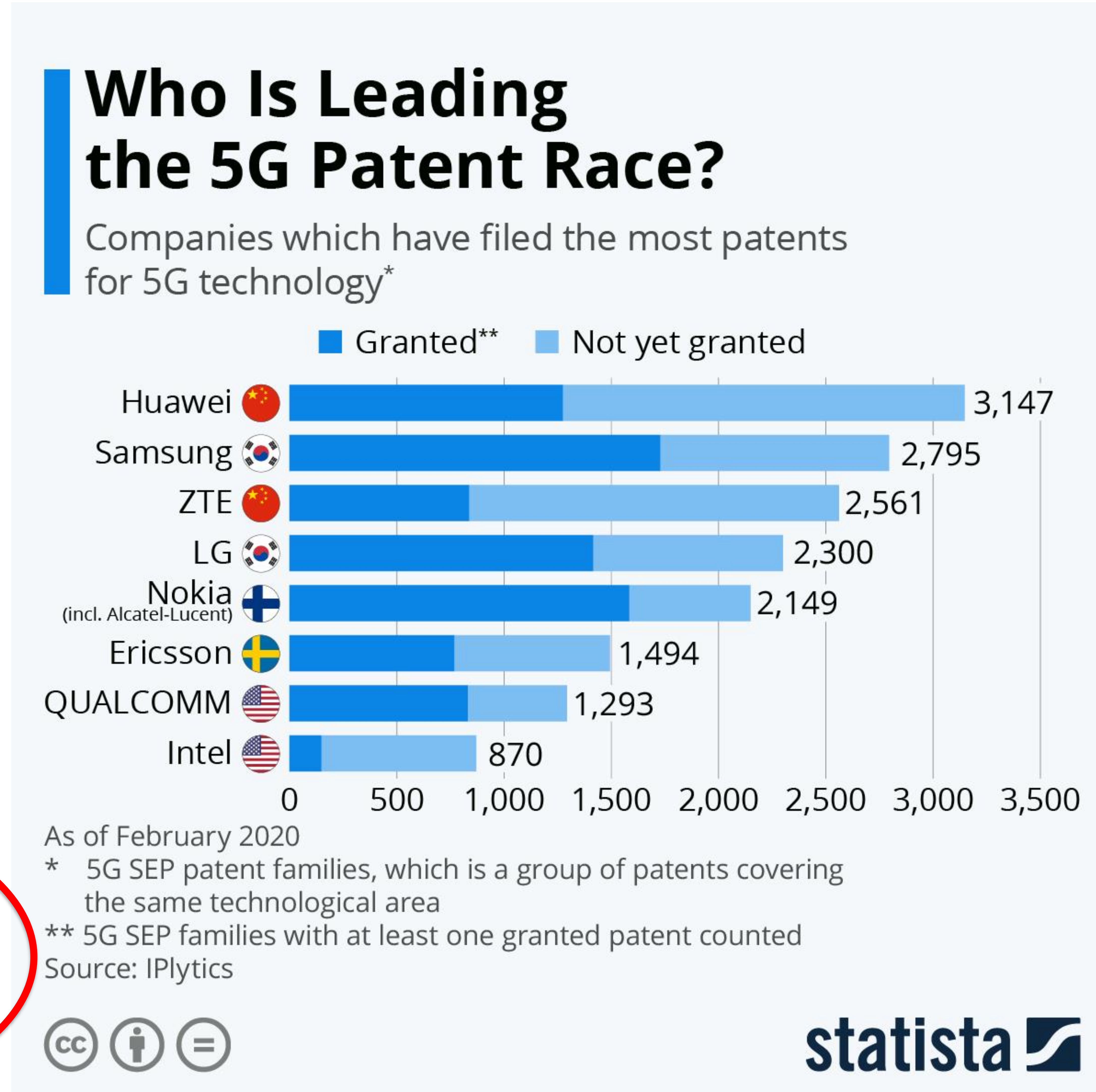




Menu
Bloomberg Businessweek
de agosto de 2020 6:01 CEST

Huawei Strengthens Its Hold on Africa Despite U.S.-Led Boycott

- Even as Europeans and Asians join Trump's ban, the Chinese company continues to prosper from the continent's move toward 5G.

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# Un Mundo Fragmentado

ELSEVIER

Materials Science and Engineering A253 (1998) 8–15

MATERIALS SCIENCE & ENGINEERING A

## Ion implantation of semiconductors

J.S. Williams

*Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering, Australian National University, Canberra 0200, Australia*

**Abstract**

Ion implantation was first applied to semiconductors over 30 years ago as a means of introducing controllable concentrations of n- and p-type dopants at precise depths below the surface. It is now an indispensable process in the manufacture of integrated circuits. This review gives a brief and selected overview of ion beam modification of semiconductors, treating both fundamental and technological issues of current interest. Damage introduction during ion irradiation and its removal during a thermal annealing step are key issues which are highlighted. Some semiconductors are easily damaged and amorphised (e.g. silicon) whereas others (e.g. gallium nitride) are quite resistant to damage production due to efficient dynamic defect annihilation during implantation. The conditions needed to remove implantation damage also vary dramatically from one semiconductor to another: amorphous layers in silicon can be recrystallised to completely remove disorder at ~600°C, whereas extended defects in gallium nitride require temperatures of >1400°C to remove them. High dose implantation can result in the formation of supersaturated solid solutions, alloys and compounds, often with intriguing properties as a result of the non-equilibrium aspects of ion implantation. Formation of silicon dioxide layers directly during oxygen bombardment of silicon, even under cryogenic implantation conditions, is given as an example. From the standpoint of semiconductor technology, there are several current issues under intense study. Two of these are highlighted with respect to silicon technology: the problems of transient enhanced diffusion of dopants during low temperature annealing due to residual implantation-induced defects, and the need to remove extremely low concentrations of metals from active device regions. Finally, some recent novel applications of implantation in compound semiconductors are treated. 

*Keywords:* Ion implantation; Semiconductors; Silicon processing; Radiation damage; Compound semiconductors

### 1. Introduction

The semiconductor industry has been the juggernaut that has driven implantation technology. There have now been >8000 implantation machines delivered to the semiconductor industry, more than 95% involved in the manufacture of advanced silicon chips alone [1]. Indeed, processing of 0.35 μm CMOS chips can involve more than 30 separate implantation steps [2]. Driven to a very large extent by requirements of the semiconductor industry, there has been an enormous research effort into a broad range of ion beam modification processes in semiconductors over the past 3 decades. For example, the production and removal of implantation damage [3–6], diffusion and electrical (optical) activation of implanted dopants during subsequent annealing [7–10], formation of insulating layers such as silicon dioxide [11] and conducting silicide layers [12] by direct implantation, controlled introduction of irradiation-induced defects to tailor specific electrical [13] and optical [14] properties, together with fundamental studies of defects [15–18] and diffusion [19–21] are all extremely active research areas.

This review briefly treats some of the above areas of research activity, concentrating on damage production and its removal in a range of semiconductors, silicon dioxide formation by oxygen implantation into silicon and a selection of recent technological applications of implantation in both silicon and compound semiconductors. Examples taken from the author's recent research will be given to illustrate each of these areas.

### 2. Damage accumulation and its removal

When an energetic ion enters a solid it loses energy by two processes: (i) by elastic or nuclear collisions with the matrix atoms causing direct atom displacements and disorder; and (ii) by inelastic or electronic processes in which the electrons of the solid are excited [3]. In

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*PII* S0921-5093(98)00705-9

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# Un Mundo Fragmentado

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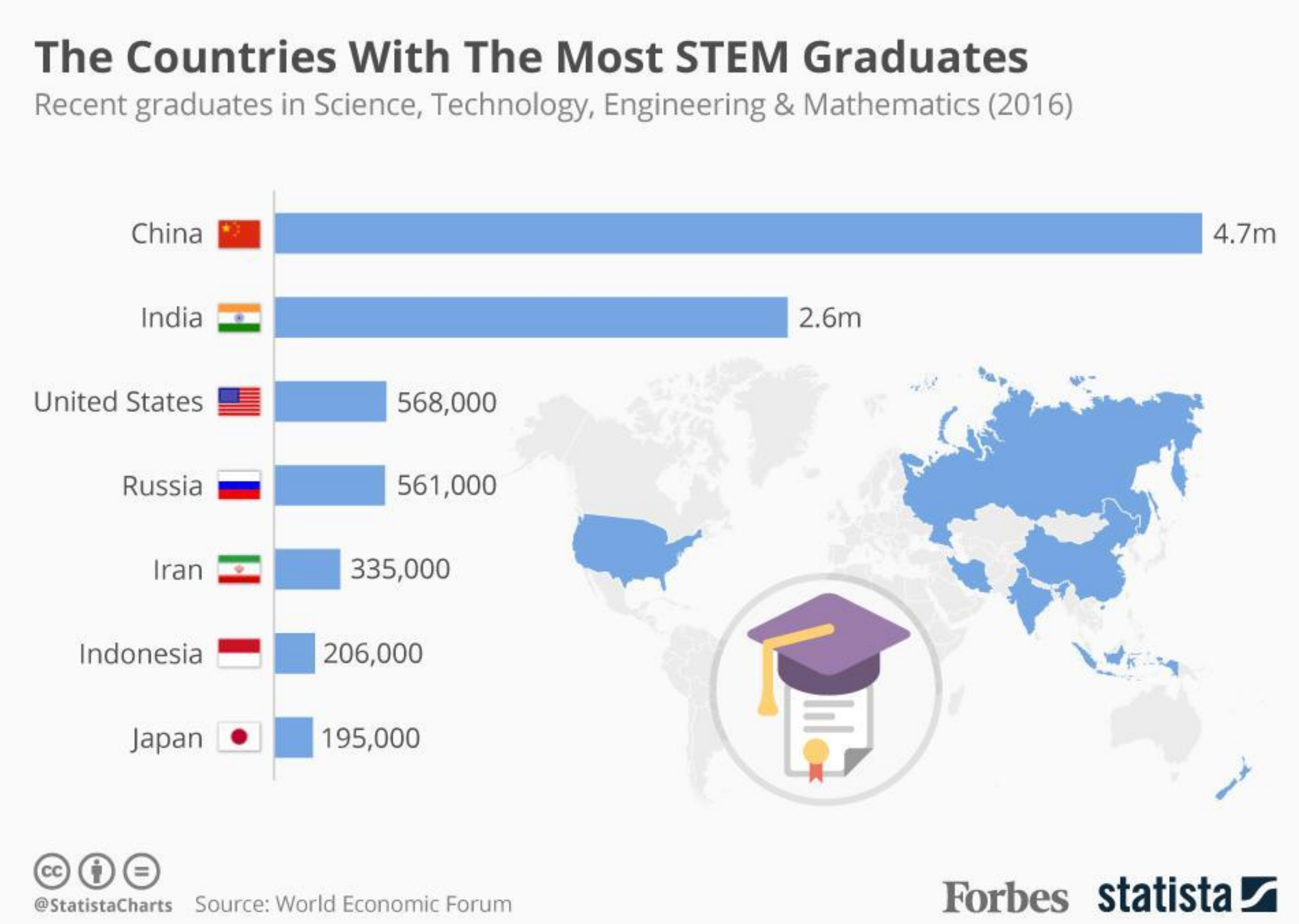
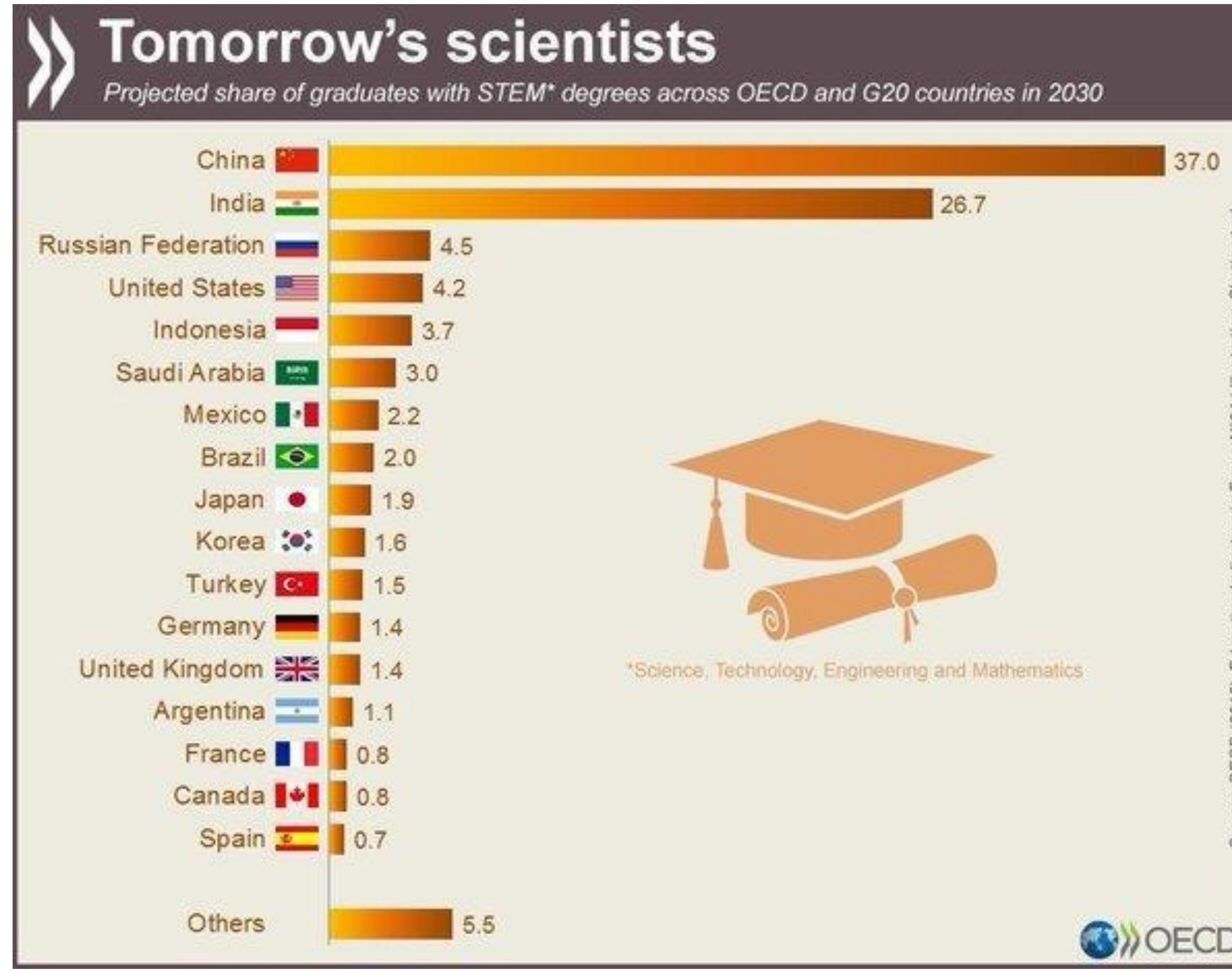
# Un Mundo STEM




## America's STEM job boom could benefit international students — here's how

TRENDING | STUDY INTERNATIONAL STAFF | 23 JUN 2021

### Computing and IT to dominate STEM jobs

According to the IIE, computer technology is the number one STEM major today. This trend corresponds with its growing application across industries, where cloud computing, big data, and information security are assuming greater importance. Experts in these areas will be able to choose from various lucrative STEM jobs.

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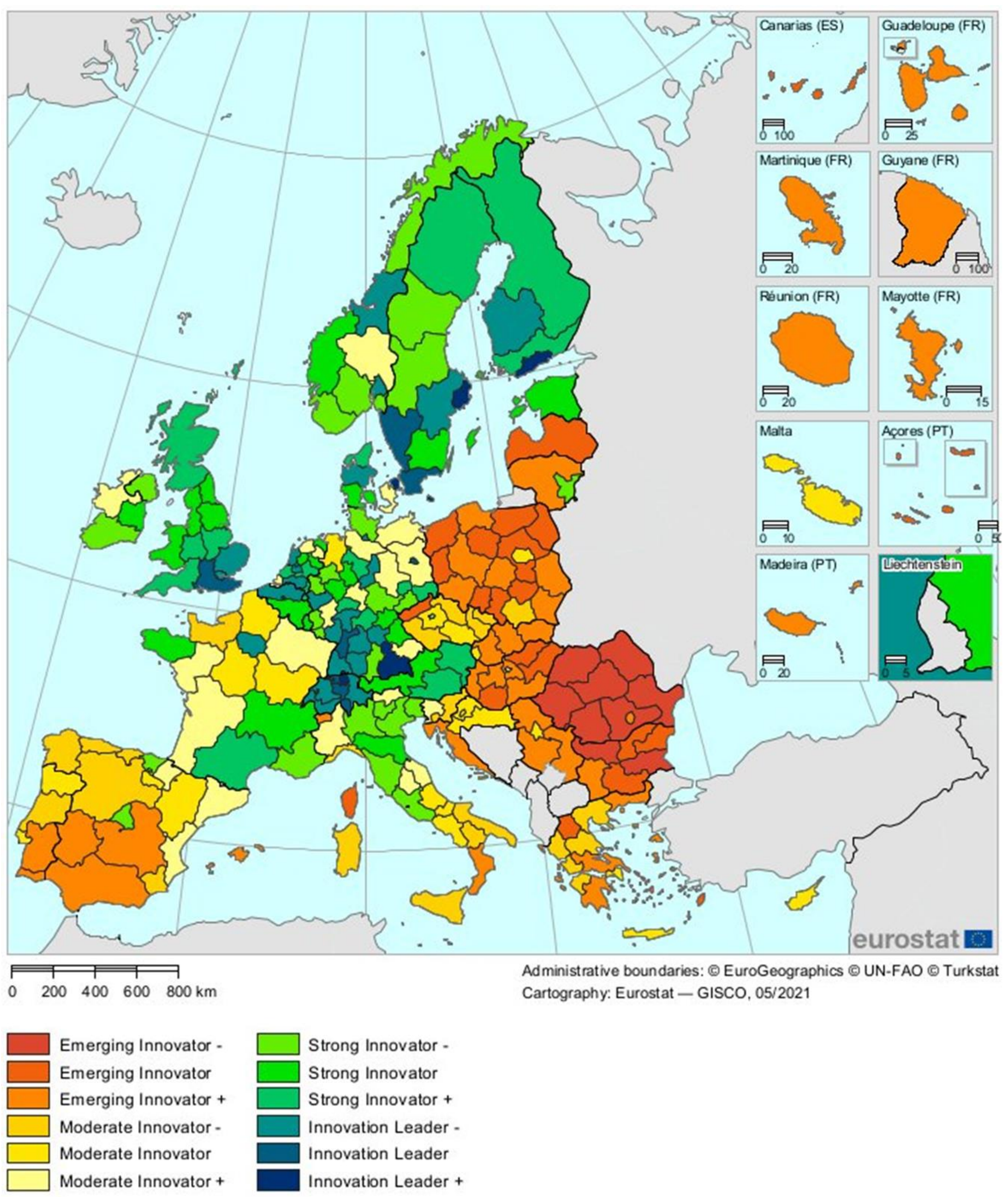
# ¿Y Europa, dónde queda?

Photographer: Alex Kraus/Bloomberg

Bloomberg Innovation Index

## Germany Breaks Korea's Six-Year Streak as Most Innovative Nation

By Michelle Jamrisko and Wei Lu
January 18, 2020, 8:15 AM GMT+1




For Cyprus, Estonia, Latvia, Luxembourg and Malta, performance group membership is identical to that in the EIS 2021 report. For these countries, the corresponding colour codes for the middle sub-group of regions have been used.

### 2020 Bloomberg Innovation Index

| 2020 Rank | 2019 Rank | YoY Change | Economy | Total Score | R&D Intensity | Manufacturing Value-added | Productivity | High-tech Density | Tertiary Efficiency | Researcher Concentration | Patent Activity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | +1 | Germany | 88.21 | 8 | 4 | 18 | 3 | 26 | 11 | 3 |
| 2 | 1 | -1 | S. Korea | 88.16 | 2 | 3 | 29 | 4 | 16 | 5 | 11 |
| 3 | 6 | +3 | Singapore | 87.01 | 12 | 2 | 4 | 17 | 1 | 13 | 5 |
| 4 | 4 | 0 | Switzerland | 85.67 | 3 | 6 | 14 | 10 | 17 | 3 | 19 |
| 5 | 7 | +2 | Sweden | 85.50 | 4 | 16 | 19 | 7 | 13 | 7 | 18 |
| 6 | 5 | -1 | Israel | 85.03 | 1 | 31 | 15 | 5 | 32 | 2 | 7 |
| 7 | 3 | -4 | Finland | 84.00 | 10 | 15 | 9 | 14 | 24 | 9 | 10 |
| 8 | 11 | +3 | Denmark | 83.22 | 7 | 24 | 6 | 8 | 31 | 1 | 24 |
| 9 | 8 | -1 | U.S. | 83.17 | 9 | 27 | 12 | 1 | 47 | 29 | 1 |
| 10 | 10 | 0 | France | 82.75 | 13 | 39 | 16 | 2 | 20 | 17 | 8 |
| 11 | 12 | +1 | Austria | 82.40 | 6 | 11 | 13 | 19 | 12 | 8 | 16 |
| 12 | 9 | -3 | Japan | 82.31 | 5 | 5 | 35 | 9 | 30 | 16 | 12 |
| 13 | 15 | +2 | Netherlands | 81.28 | 17 | 28 | 17 | 6 | 36 | 12 | 14 |
| 14 | 13 | -1 | Belgium | 79.93 | 11 | 25 | 11 | 13 | 49 | 14 | 13 |
| 15 | 16 | +1 | China | 78.80 | 15 | 14 | 47 | 11 | 5 | 39 | 2 |
| 16 | 14 | -2 | Ireland | 78.65 | 34 | 1 | 1 | 12 | 39 | 20 | 34 |
| 17 | 17 | 0 | Norway | 76.93 | 16 | 51 | 5 | 20 | 10 | 10 | 22 |
| 18 | 18 | 0 | U.K. | 76.03 | 21 | 44 | 27 | 15 | 6 | 19 | 21 |
| 19 | 21 | +2 | Italy | 75.76 | 24 | 23 | 21 | 16 | 33 | 25 | 20 |
| 20 | 19 | -1 | Australia | 74.13 | 18 | 55 | 8 | 21 | 15 | 31 | 6 |
| 21 | 31 | +10 | Slovenia | 73.93 | 19 | 8 | 20 | 40 | 14 | 15 | 26 |
| 22 | 20 | -2 | Canada | 73.11 | 22 | 35 | 26 | 26 | 35 | 21 | 9 |

**CAREER GUIDE** · 27 MARCH 2019

## How Germany is winning at turning its research to commercial application

The country is using science for economic benefit.

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# Alemania: Impulso a la Industria 4.0

MENU

Harvard Business Review

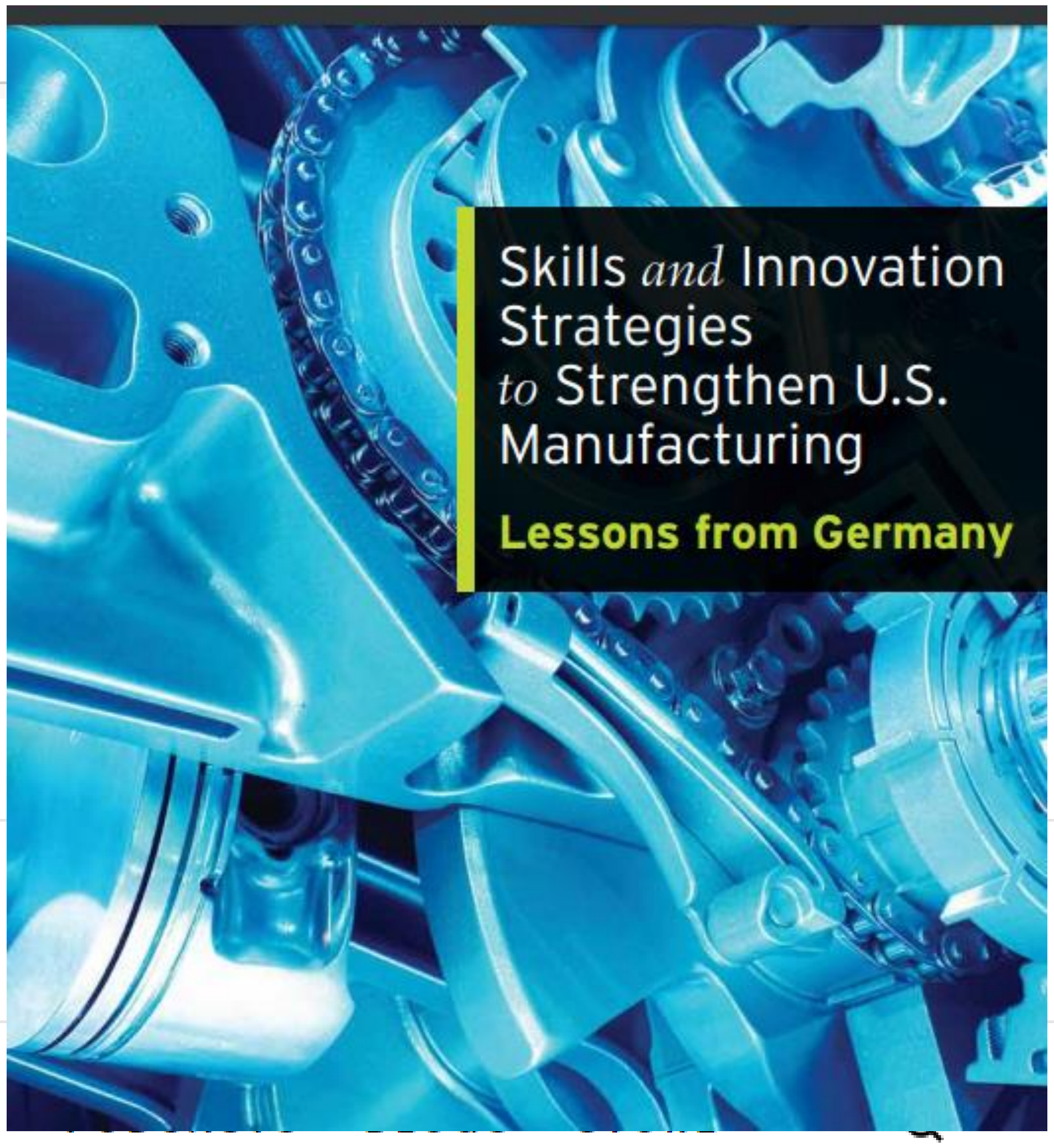
INNOVATION

## Why Germany Dominates the U.S. in Innovation

by Dan Breznitz

MAY 27, 2014

172

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TECH

## The U.S. Could Learn from Germany's High-Tech Manufacturing

Germany has developed a flexible and effective way of moving its best ideas from the university labs to the factory floor

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# Alemania: Impulso a la Industria 4.0

**Table 1. Germany vs. the United States on Key Economic Indicators**

| | Germany | United States |
|---|---|---|
| **Economic Output** | | |
| *Share of GDP in Manufacturing* | 22% | 12% |
| *Share of Manufacturing GDP in Medium & High-Tech Manufacturing* | 58% | 42% |
| **Trade** | | |
| *Total Exports as a Share of GDP* | 52% | 14% |
| *Share of Merchandise Exports in Manufacturing* | 82% | 62% |
| *Trade Balance in Manufactured Goods* | $425 billion | -$668 billion |
| **Innovation** | | |
| *Total Researchers Per 1000 Workers* | 8.22 | 8.08 |
| *R&D Expenditures as a Share of GDP* | 2.98% | 2.79% |
| *Share of Corporate R&D in Manufacturing* | 86% | 68% |
| *Number of Top 50 Universities in Leiden Impact Rankings* | 0 | 39 |
| *Patents per 1000 Researchers* | 53.03 | 38.74 |
| *New Firm Entrants as a Share of Total Firms* | 7.90% | 8.50% |
| **Workforce** | | |
| *Share of Employment in Manufacturing* | 20% | 10% |
| *Average Hourly Compensation in Manufacturing* | $45.79 | $35.67 |
| *Share of Graduates in STEM Fields (OECD Rank/36)* | 3 | 33 |
| *Youth Unemployment Rate* | 8% | 14% |

*Source: World Bank and OECD national accounts data; OECD Science and Technology Indicators; CWTS Leiden Ranking; OECD Entrepreneurship at a Glance data; U.S. Bureau of Labor Statistics.*

Economía

Merkel enciende la maquinaria del capitalismo de Estado para crear nuevos campeones alemanes

**https://www.brookings.edu/wp-content/uploads/2016/06/LessonsFromGermany.pdf**

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# Alemania: Impulso a la Industria 4.0

## Innovation Clusters

Close Cooperation between Governments of German Länder, Universities, Industry and Fraunhofer


1 Digital Production
2 Mechatronic Machine Systems
3 Optical Technologies (JOIN)
4 Automotive Quality Saar
5 Digital Commercial Vehicle Technology (DNT)
6 Nano for Production
7 Personal Health
8 Adaptronics
9 Future Security BW
10 Technologies for Hybrid Lightweight Construction (KITe HyLITE)
11 Multifunctional Materials and Technologies (MultiMaT)
12 Polymer Technologies
13 Virtual Development, Engineering and Training (VIDET)
14 Turbine Production Technologies (TurPro)
15 Secure Identity
16 Maintenance, Repair and Overhaul in Energy and Traffic (MRO)
17 Electronics for Sustainable Energy Use (under developm.)
18 Cloud Computing for Logistics (under development)



Fraunhofer

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# Alemania: Impulso a la Industria 4.0

Fraunhofer

## Microelectronics

- CNT, Dresden
- ENAS, Chemnitz
- ESK, München
- HHI, Berlin
- IAF, Freiburg
- IIS, Erlangen
- IISB, Erlangen
- IMS, Duisburg
- IPMS, Dresden
- ISIT, Itzehoe
- IZM, Berlin
- FHR, Wachtberg

Guest:

- Fokus, Berlin
- IDMT, Ilmenau
- IZFP, Saarbrücken

## Materials and Components - MATERIALS

- EMI, Freiburg
- IAP, Potsdam
- IBP, Stuttgart
- ICT, Pfinztal
- IFAM, Bremen
- IKTS, Dresden
- ISC, Würzburg
- ISE, Freiburg
- ISI, Karlsruhe
- IWM, Freiburg
- IZFP, Saarbrücken
- LBF, Darmstadt
- WKI, Braunschweig

Guest:

- ITWM, Kaiserslautern
- IGB, Stuttgart

## Production

- IFF, Magdeburg
- IML, Dortmund
- IPA, Stuttgart
- IPK, Berlin
- IPT, Aachen
- IWU, Chemnitz
- UMSICHT, Oberhausen

## Light & Surfaces

- FEP, Dresden
- ILT, Aachen
- IOF, Jena
- IPM, Freiburg
- IST, Braunschweig
- IWS, Dresden

## Life Sciences

- IBMT, St. Ingbert
- IGB, Stuttgart
- IME, Schmallenberg, Aachen
- ITEM, Hannover
- IVV, Freising
- IZI, Leipzig
- EMB, Lübeck

## ICT Group

- FIRST, Berlin
- FIT, St. Augustin
- FOKUS, Berlin
- IAIS, St. Augustin
- IAO, Stuttgart
- IDMT, Ilmenau
- IESE, Kaiserslautern
- IGD, Darmstadt
- IOSB, Karlsruhe
- ISST, Berlin
- ITWM, Kaiserslautern
- MEVIS, Bremen
- SCAI, St. Augustin
- SIT, Darmstadt
- FKIE, Wachtberg

Guest:

- ESK, München
- HHI, Berlin
- IIS, Erlangen

## Defense and Security

- EMI, Freiburg
- IAF, Freiburg
- ICT, Pfinztal
- INT, Euskirchen
- FHR, Wachtberg
- FKIE, Wachtberg
- IOSB, Karlsruhe

Guest:

- IIS, Erlangen
- HHI, Berlin

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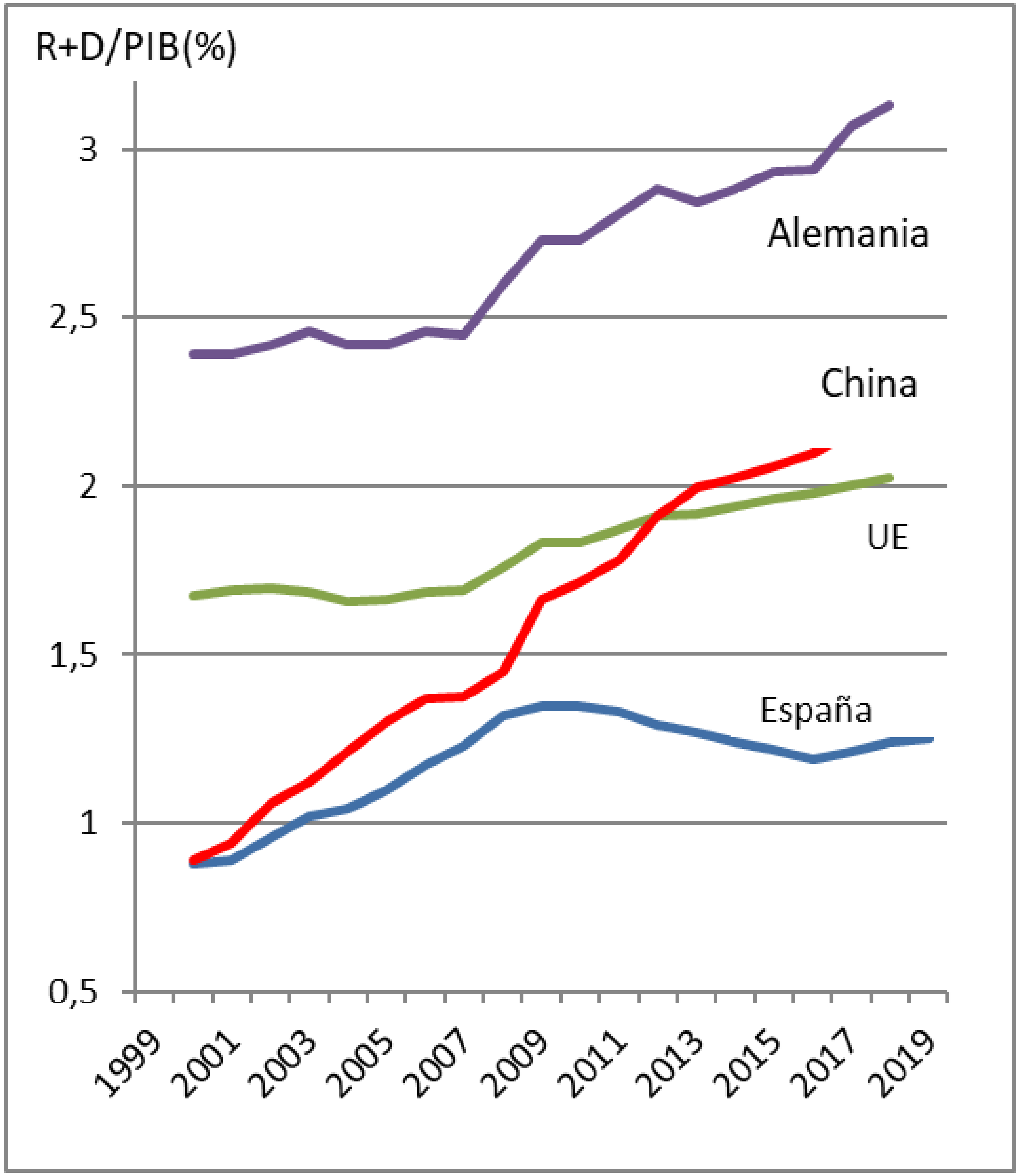
# I+D Industrial: Una emergencia nacional



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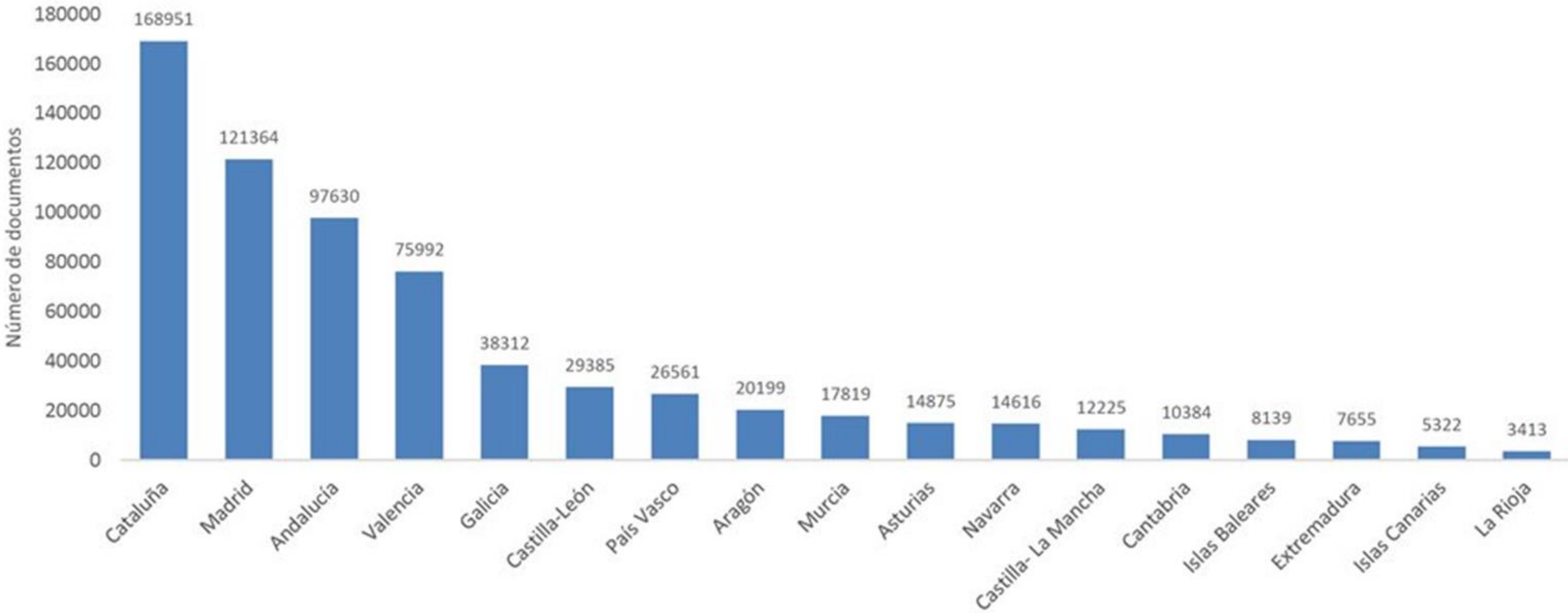
# Con la ciencia no es suficiente

**Gráfico 26. Distribución de la producción científica en WoS por comunidades autónomas. Total para el periodo 2010-2019.**




INVESTIGACIÓN

## Grecia, Portugal y Polonia superan a España en I+D y la hunden en la cola europea

• El país, además, no ejecuta ni la mitad de la asignación presupuestaria prevista

# I+D Industrial: Una emergencia nacional



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# Para los escépticos de "no hay recursos"



ATC ASOCIACIÓN ESPAÑOLA TÉCNICOS CERÁMICOS

*Source: The Power of Creative Destruction. P. Aghion (2021)*

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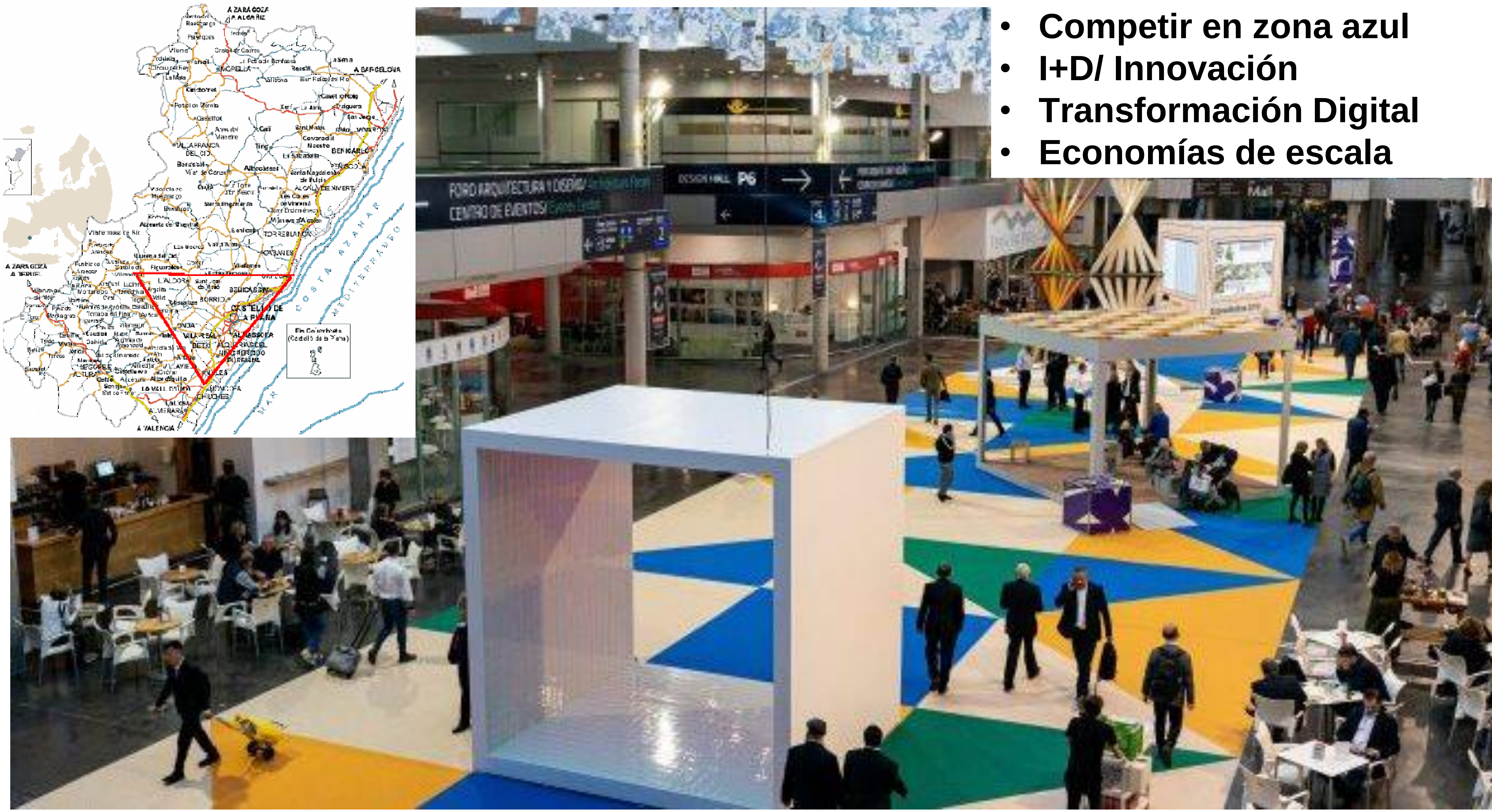
# El clúster cerámico… Clúster e industria




- **Competir en zona azul**
- **I+D/ Innovación**
- **Transformación Digital**
- **Economías de escala**

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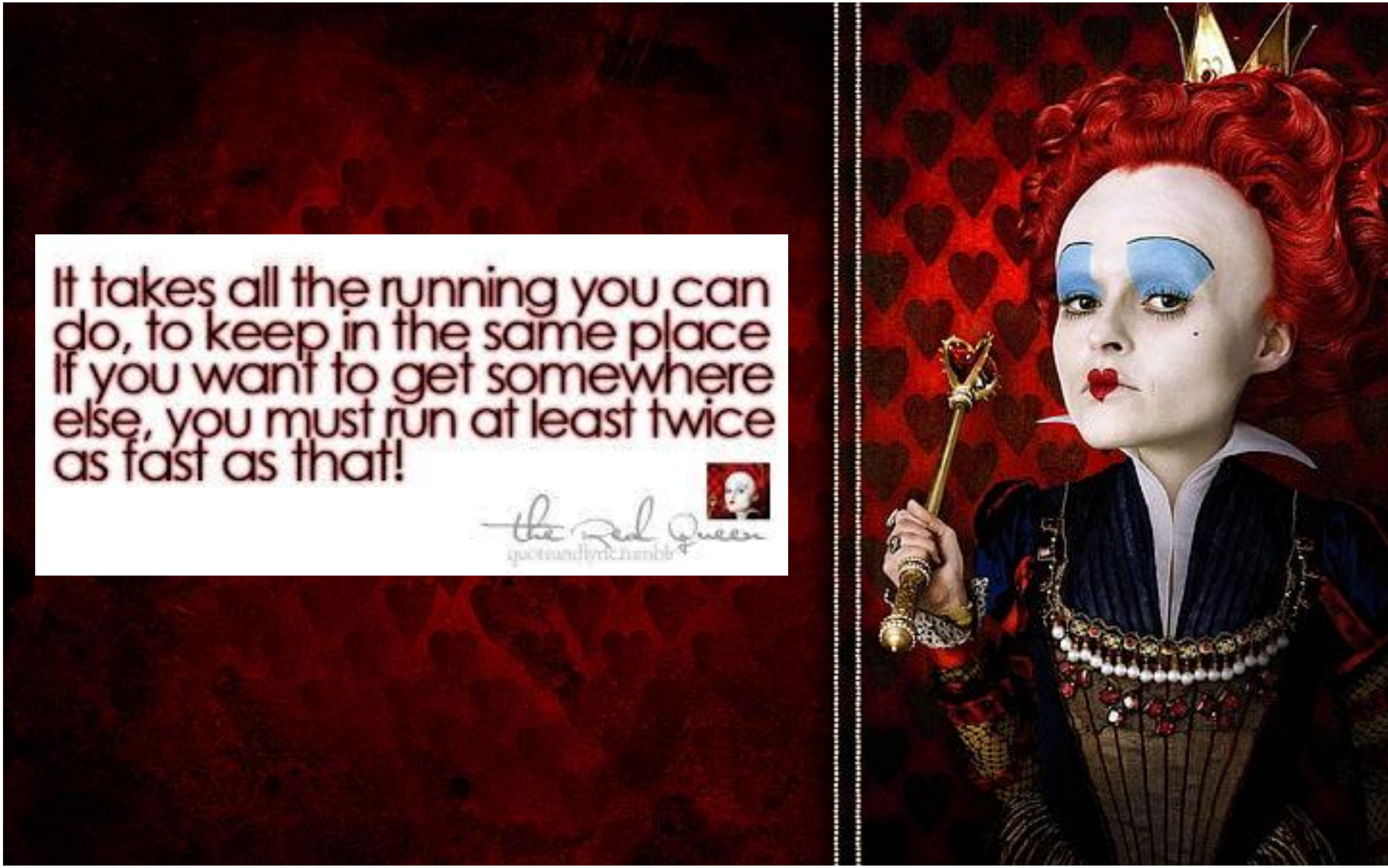
# El nuevo mundo de la I+D puede ser El País de las Maravillas, pero…

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**Thanks for your attention!**
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