

Understanding innovation

Iarla Kilbane-Dawe

Φ-lab, EOP-Φ-Future Systems Department

Is innovation important?



“We are witnessing a revolution in the field of EO. New Space or Space 4.0 is largely driven by the private sector: small start-ups, but also ICT giants. This revolution is .. now affecting all aspects of space technologies, changing at an exponential rate, dramatically lowering of barriers to entry, so that a new generation of space entrepreneurs can now start doing business with space at a lower cost.”

Josef Aschbacher, ESRIN Director



“Compared to other industries, I have never seen such an enormous margin for improvement. There’s this canonical thing about a startup needing to pitch a 10X improvement to be a worthwhile investment.

You rarely see an entrepreneur pitch a 100X improvement. But in space we’ve seen 1,000X, and really we’ve seen 10,000X.”

Steve Jurvetson, VC investor in Planet

“Space 4.0 is about companies outside of space and companies in space working together for the positive development of humankind. We must network these actors together into a seamless, collaborative Space 4.0 production chain”

**Jan Woerner
Head of ESA**



A canter round the topic of innovation



- What is innovation?
- How do we go from ideas or research to innovations?
- The most important skill for successful innovation
- We'll also do some exercises

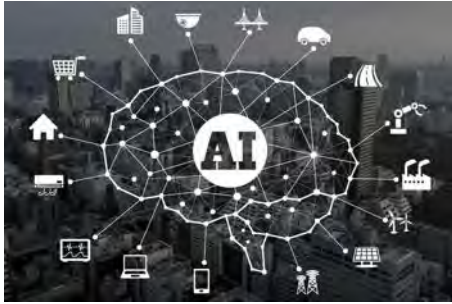


**Take 2 minutes to write 80-120
words that explain your research.**



What is innovation?

What is innovation? Give me some examples..



What is innovation? Give me some examples..

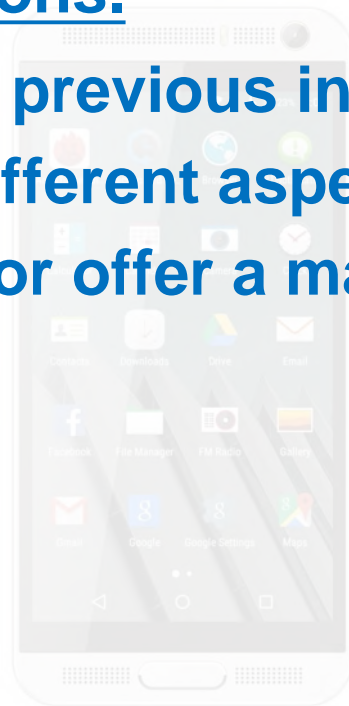
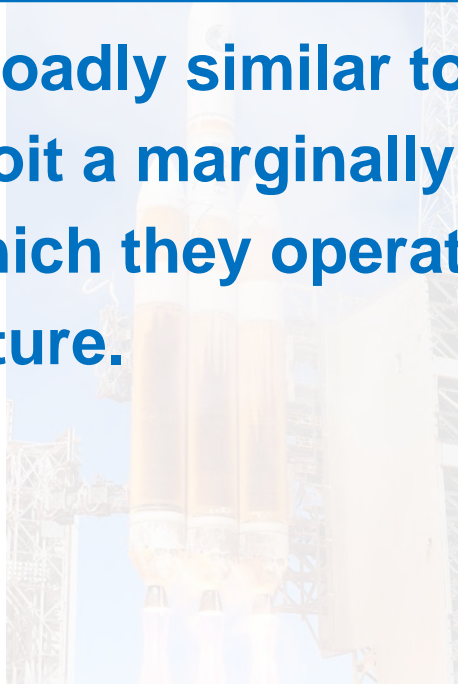
- These are all disruptive innovations.
- These are all novelties that transformed some area of human activity. Each is a combination of radical technical or process improvements.
- They are often developed by cross-fertilisation of concepts from one domain to another.

What about these examples? Are these innovations?



What about these examples? Are these innovations?

- They are incremental innovations.
- These are broadly similar to a previous innovation, and seek to exploit a marginally different aspect of the market in which they operate or offer a marginally different feature.



So what is an innovation then?



- **An improvement that's new to the organization, the market, or the World**

Josef Schumpeter, 1934

Five types of innovation

- new products
- new methods of production,
- new sources of supply,
- opening of new markets,
- new ways of organizing businesses.

OECD Frascati Manual 2014

An innovation is the implementation of a new or significantly improved

- product (good or service),
- process,
- a new marketing method,
- a new organisational method (in business practices, workplace organisation or external relations).

So what is an innovation, according to economists?



A new idea \neq A successful innovation

A successful innovation = A new idea that gets adopted

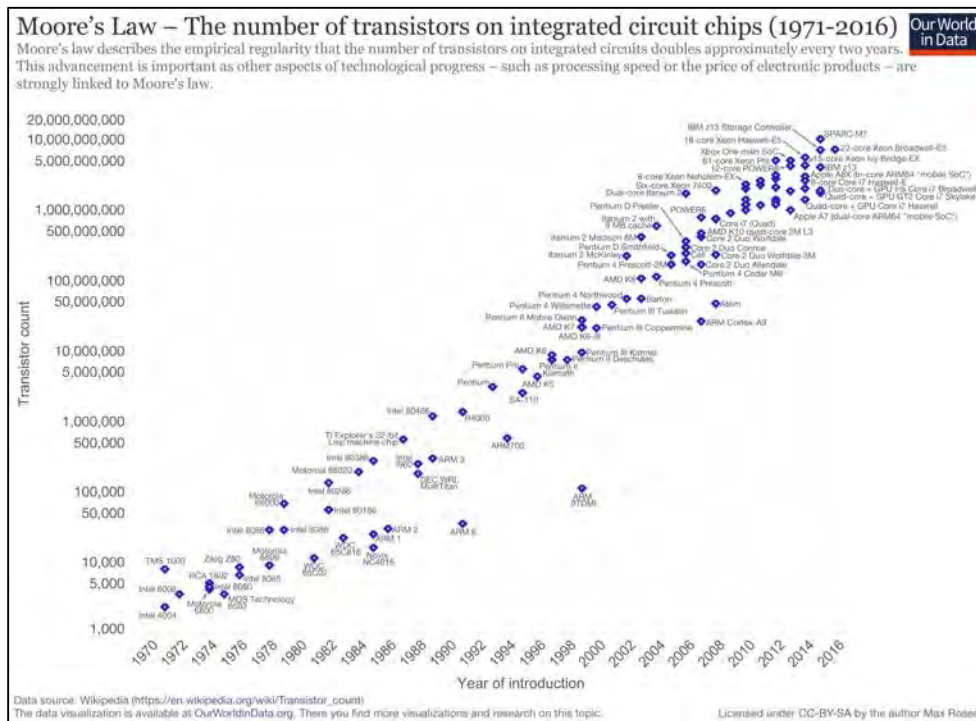
[Successful innovations] \approx [New ideas] \times 1%-5%



Why are economists so interested in innovation?

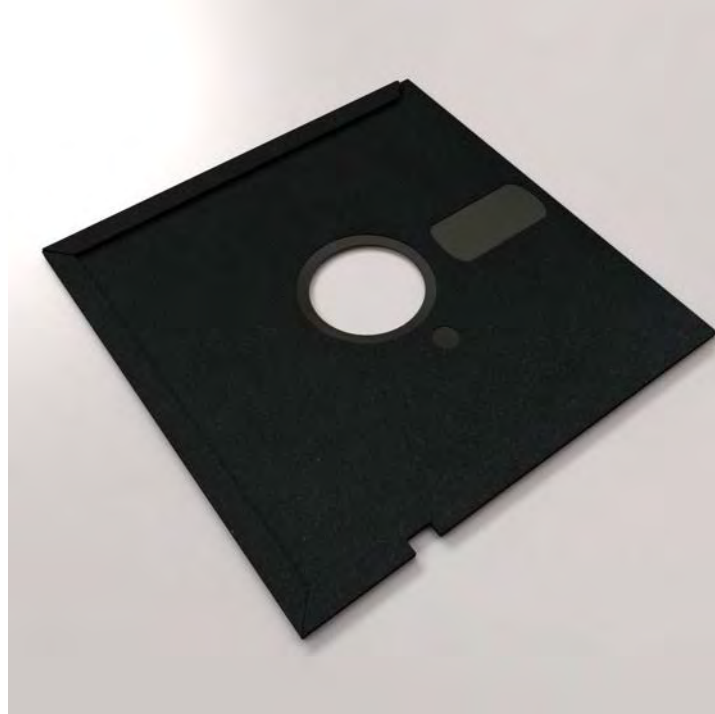
Why innovate at all?

- Efficiency



Why are economists so interested in innovation? Why innovate at all?

- Efficiency
- Obsolescence



Why are economists so interested in innovation?

Why innovate at all?

- Efficiency
- Obsolescence
- Competition



Why are economists so interested in innovation?

Why innovate at all?

- Efficiency
- Obsolescence
- Competition
- Growth

The most innovative companies predict 62% growth compared with 35% global average - PwC

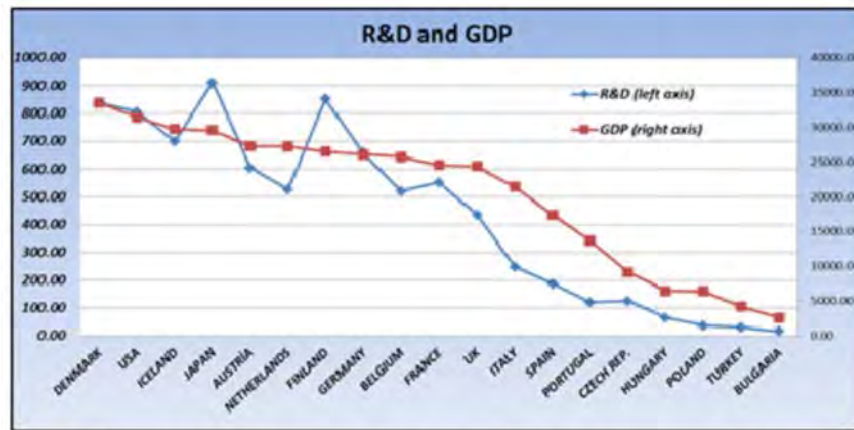


Fig. 2. R&D expenditures per capita and Gross Domestic Product (GDP) per capita (1990-2013)

“Innovation leading to increased productivity is the fundamental source of increasing wealth in an economy.” <https://doi.org/10.1016/j.sbspro.2015.06.474>

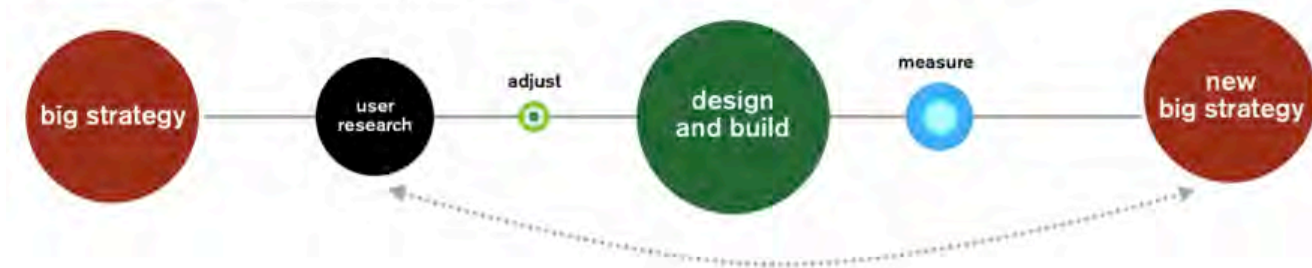


How do we get from research to innovation?

Basic steps to turning your idea into an innovation

Conventional, linear development process

Big ideas, big bang launch, big budgets



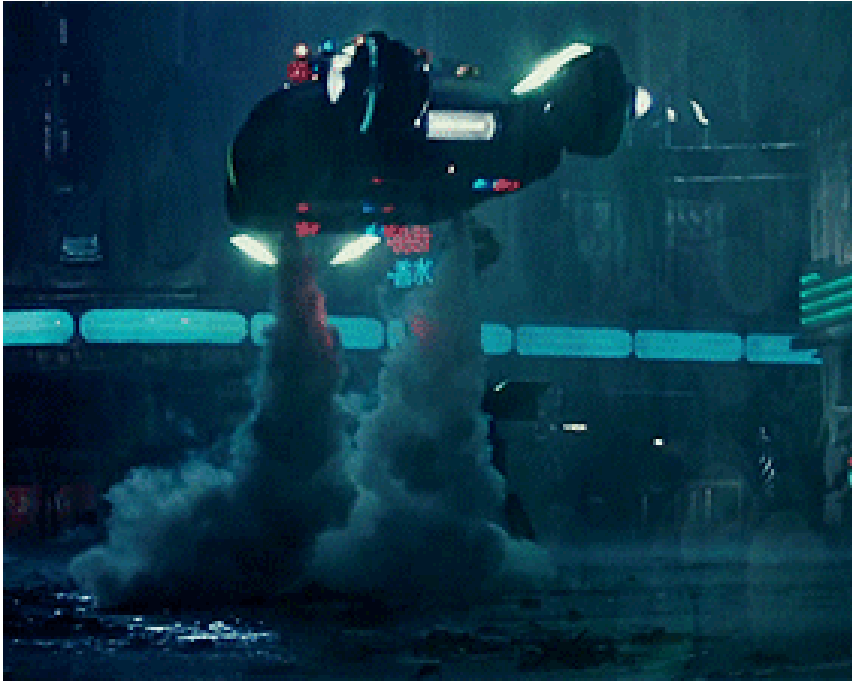
- **Research the market** - see if it's already being done and whether you can do it any better.
- **Find business partners, whose knowledge and skills complement yours** (e.g. marketing, design, delivery, sales, accounts, legal, advertising)
- **Prototype the proposed innovation, investing your own time and money** in building the prototype. It might only be a mock-up if you have little or no money.
- **Test the prototype with real customers.** Adjust it based on lessons learned.

What are the criteria for a viable innovation?

- Product development requires huge investment **as ~1%-5% succeed.**
- Average time to market for a disruptive innovation in 2011 **was 15 years** (Fitzgerald, Wankerl & Schramm, 2011).
- To keep costs down, governments and companies design their innovation (or R&D) programmes to **test promising research against core criteria for future viability.**

	Booz Allen Hamilton	De Brentani	Cooper & Kleinschmidt	Duerr
Fits company's strongest resources	✓	✓	✓	✓
Match customer needs	✓	✓	✓	
Screening for growth potential		✓	✓	✓
Top management support	✓		✓	✓
Uses new product process	✓		✓	✓
High value to customer		✓	✓	
Innovative		✓	✓	
Technical superiority	✓		✓	
Communication amongst company functions		✓	✓	
Avoids unnecessary risk		✓	✓	
Favourable competitive environment	✓			

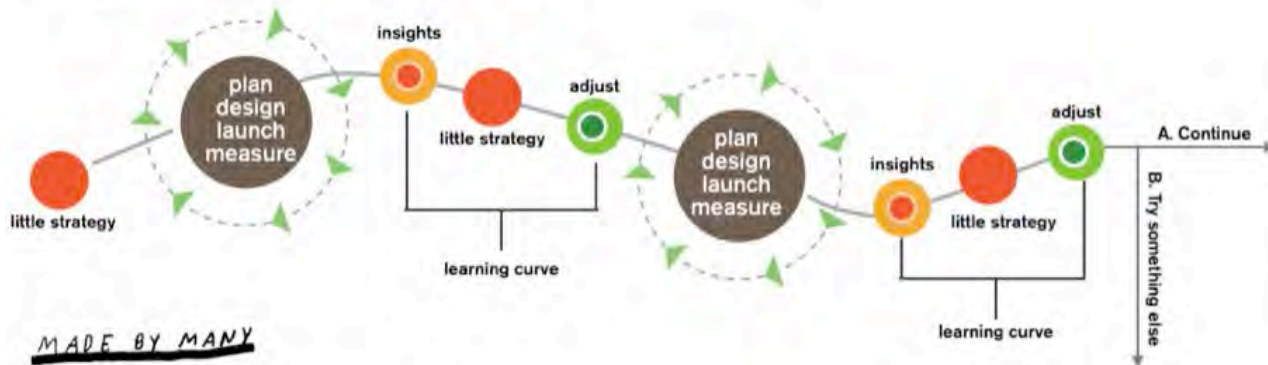
How do we get from research to innovation?



Agile development cuts costs and time to market

Iterative, Agile, emergent development process

Micro-strategies, big insights, rapid iterations



- **Agile methods combine marketing, design and user testing into a single small step of prototyping and testing.**
- Emphasis is on working prototypes, emergent teams, collaborative and cross disciplinary work, user testing and responding to change.
- Upfront planning & teaming is minimised, as are comprehensive documentation, process and tool development and formalization.
- “Simplicity, the art of maximizing the amount of work not done, is essential.” ***The Agile Manifesto***

- # Gartner Hype Cycle for Emerging Technologies, 2017
-
- The chart illustrates the Gartner Hype Cycle for Emerging Technologies, 2017. The Y-axis represents 'Expectations' and the X-axis represents 'Time'. The cycle is divided into five phases: Innovation Trigger, Peak of Inflated Expectations, Trough of Disillusionment, Slope of Enlightenment, and Plateau of Productivity. Technologies are plotted along a curve, with their time to reach the plateau indicated by colored markers.
- Technologies plotted (from top to bottom):
- Virtual Assistants
 - IoT Platform
 - Smart Robots
 - Edge Computing
 - Augmented Data Discovery
 - Smart Workspace
 - Brain-Computer Interface
 - Quantum Computing
 - Digital Twin
 - Serverless PaaS
 - 5G
 - Human Augmentation
 - Neuromorphic Hardware
 - Deep Reinforcement Learning
 - Artificial General Intelligence
 - 4D Printing
 - Smart Dust
 - Connected Home
 - Deep Learning
 - Machine Learning
 - Autonomous Vehicles
 - Nanobute Electronics
 - Cognitive Computing
 - Blockchain
 - Commercial UAVs (Drones)
 - Cognitive Expert Advisors
 - Enterprise Taxonomy and Ontology Management
 - Software-Defined Security
 - Augmented Reality
 - Virtual Reality
- Plateau will be reached in:
- less than 2 years (grey circle)
 - 2 to 5 years (blue circle)
 - 5 to 10 years (dark blue circle)
 - more than 10 years (yellow triangle)
- As of July 2017
- gartner.com/SmarterWithGartner
- Source: Gartner (July 2017)
© 2017 Gartner, Inc. and/or its affiliates. All rights reserved.
- Gartner

What are the emerging trends in EO?



- Reusable rockets
- Artificial Intelligence
- Cubesats and nanosats
- Constellations
- Quantum sensing
- Quantum computing
- Laser based communication
- Quantum entangled comm's
- Queue & tilt
- Combinations of big sats & small sats
- Fusion of EO and non-EO satellite & other data
- Space as a service
- Silicon Valley investment
- Agile, rapid development

**Take 2 minutes to write 80-120
words that explain your research
to an investor.**



The most important skill for successful innovation

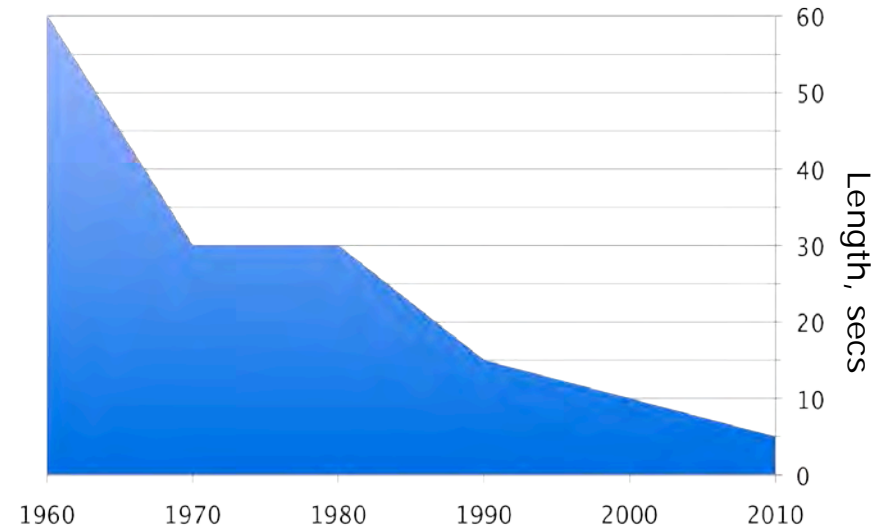
In science we are used to ...

- Being listened to for long periods and through detailed explanations.
- Highly literate, knowledgeable audiences.
- Evidence based reasoning.

Most people are not like this

- In the UK, 70% of people don't understand percentages.
- A similar proportion cannot understand sentences longer than 23 words.

Minimum length of TV Commercials



Moreover, most decisions people make aren't based on numbers or other evidence



What fact about air pollution is most engaging?

- About 10% of deaths in London are attributable to air pollution.
- The main health outcomes of air pollution are cardiovascular disease, strokes and cancer.
- Air pollution includes exhaust gases, bits of brakes and tyres, and ground up stuff on the road. This coats the inside of your lungs and travels to other organs in your body.

Technical people are often really bad at communication.

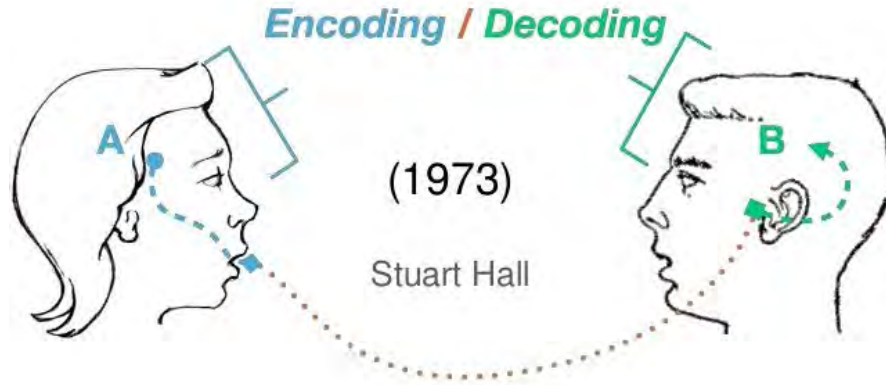
“XXXXXXXXX is a new project under ESA’s InCubed programme, but indeed it is more than a project - it is an innovative, fast response system that will answer several critical demands along the agro-food value chain. Issues range from e.g. losses during breeding and logistics, control capacities for productions and trading, to the development of new markets. XXXXXXXXX will support agro-food industries in the identified value chain challenges and thus support their growth targets.

The design of the XXXXXXXXX agile system allows self-onboarding and data driven scalability providing fast direct access to Earth observation data streams. Thereby, XXXXXXXXX circumvents traditional service models. This innovative industry based system solution breaks barriers and facilitates global scalability.”

“The food industry and farmers growing potatoes and other crops will soon save money, get better prices and help protect their crops from disease using data collected by satellites and sent directly to them, funded by the European Space Agency. The satellite data will be used to initially develop three services for the potato industry, to help with storage, trading and disease monitoring. As the developed system is scalable the services can be expanded to different topics and sectors. Agriculture is a low margin industry and increasing margins on the 53 million tonnes of potatoes produced in Europe each year will save millions for this €7 billion industry.

**Take 2 minutes to write 80-120
words that explain your research
to your grandmother.**

To communicate with the vast majority of the population, you must use **clear simple language**, short sentences and nothing numerical or mathematical. You must **customise your communication for your audience**.



Blaise Pascal

"I'm sorry I wrote you such a long letter. I didn't have time to write you a short one."

Advice for future innovators



- Innovation is **not about having a better idea**, it's about your idea being adopted.
- You ensure adoption of your new good idea, **by refining and developing your idea through communication with others.**
- To be a successful innovator, **invest effort into developing your communication skills**, as you'll need these very step along the way.

